NERAL LIBRA

VOL. LXXXIV. No. 2161. [All Rights Reserved.] APRIL 25, 1919. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of Postage.] PRICE FOURPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C.4. SUBSCRIPTION per annum, Postage inclusive in Great Britain, £1 1s. 8d. Canada, £1 8s. 10d. ($5.80); to all other countries, 30s.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque.
Telegraphic Address: "Ageekay, Cent., London." A B C Code. Telephone Nos. City 997: Central 4425 (Editorial only).

**LITHOLITE, Ltd.,**
55—57, Hackney Grove, London, E. 8.
'Phone and Telegrams: Dalston 592, London.
MANUFACTURERS OF
**MOULDED INSULATORS,**
FIREPROOF AND OTHER GRADES.
ESTABLISHED NEARLY 20 YEARS.

AIR COMPRESSORS
& VAC. PUMPS,
Desiccators
Sets.
NORMAN DICKSON, PRINGLE & CO.
Cable
Pumps &
Impregnators
25, Victoria St., Westminster, S.W. 1

**WRIGHT** 'Phone: 499 Tel.: Motor.
A.C. and D.C. **MOTORS.**
WRIGHT MOTORS, Ltd., HALIFAX.

EVERY DESCRIPTION OF
**SMALL TURNED PARTS and CASTINGS for ELECTRICAL ENGINEERS.**
A. MORTON,
6, Tenby Street North, Birmingham.

**BROOK, ONE, TWO and THREE-PHASE MOTORS.**
See Sup. 46.

**SWITCHGEAR.**
ERNEST F. MOY, LTD.,
Manufacturing Electrical Engineers and Government Contractors.
GREENLAND PLACE, CAMDEN TOWN, LONDON.

**MICA & MICANITE**
TAYLOR & PETTERS, LTD.,
40, Hatton Garden, London, E.C.1.
'Phone: 4575 Central. (See Page ii.)

Osram, Mazda, Wotan, "Z" and other Conference Lamps.
Pocket Lamps, Torches, Batteries, &c.
E. DAWSON & CO.
(W. E. POTT).
10, GRAY'S INN ROAD, London, W.C. 1
Telephone: HOLBORN 2784.

**CHURTON**
SINGLE and POLYPHASE
**MOTORS.**
T. HARDING CHURTON & CO., LTD.,
Atlas Works, Water Lane, LEEDS.

**SKATOSKALO**
**BOILER SCALING TOOLS.**
Sole Maker:
FRANK GILMAN,
9, Westfield Road, BIRMINGHAM.
See Advertisement this week, page xxxvii.

**"EMPIRE"**
**AUTOMATIC CONTROL**
FOR
Pumps, Compressors, Machine Tools.
ELECTRIC CONTROL, LIMITED, GLASGOW.

**WESTERN-ELECTRIC**
COMPANY, LIMITED,
Norfolk House, Victoria Embankment, W.C. 2
Works: NORTH WOOLWICH, LONDON, E
TELEPHONES & CABLES.
See Advertisement last week, Sup. 12.

**CONNOLLY BROS., Ltd.,**
for
WIRES AND CABLES.
See Advertisement this week, p. iii.

**WHITE**
Electrical Instrument Co., Ltd.
2, 4, & 6, GLOUCESTER ST.,
CLERKENWELL, LONDON, E.C. 1.
Wire: Voltograph, London. 'Phone: City, 8660.

**ELECTRIC MOTORS.**
One, Two and Three-Phase.
BRITTAIN'S ELECTRIC MOTOR Co.
(Late Langdon-Davies Electric Motor Co.),
110, Cannon Street, London, E.C. 4.

**INSULATING**
**- - BEADS -**
Immediate Delivery.
HOLDER-HARRIDEN LTD., 35/37, Noble St., London, E.C.

THE HALTERED STEER.
See Page xl.

Better than Rubber, Leather and Gutta-Percha.
**PACKING RINGS.**
DERMATINE
DERMATINE CO., Ltd.,
Neate St., London, S.E. 5

LARGE STOCK KEPT FOR QUICK DELIVERY
**SHUNT REGULATORS,**
MOTOR STARTERS and all classes of Resistance Work.
The SOLENOID REGULATOR Co. (GEORGE A. YARWOOD, Proprietor),
HIGHGATE SQUARE, CAMP HILL,
Telephone: Midland 592. BIRMINGHAM Telegrams: "Solenoid, Birmingham."

**MAVOR & COULSON, Ltd.,**
GLASGOW.
**MOTORS, DYNAMOS, SWITCHGEAR.**

ELECTRIC MOTOR REPAIRS.
ARMATURES REWOUND.
H. DUNN & SON,
Newington Causeway,
Tel.: Hor. 1167. LONDON, S.E. 1

**THERMIT, LIMITED,**
(Proprietors: NOBEL'S EXPLOSIVES CO., LTD., GLASGOW.
875, Commercial Road,
LONDON, E. 14.
'Phone: EAST 4157. Grams: "FULMEN, PHONE LONDON."

Makers of— **FULLER,**
WIRES & CABLES,
ACCUMULATORS,
BATTERIES,
CARBONS.
CHADWELL HEATH, ESSEX.

**INGLEBY & CO., LTD.**
ELLAND ROAD, LEEDS.
MOTORS FOR DIRECT AND ALTERNATING CURRENT
Tel. 378
Delivery from Stock up to 50 H.P.

*Advertisement Index, see page xxxvi.*

ENGLISH
EDISWAN
EVERYTHING
ELECTRICAL

The house of Ediswan is the best equipped to deal with all enquiries for

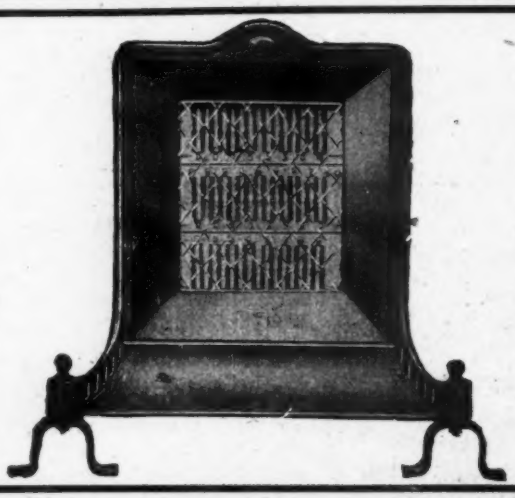
Everything
Electrical.

ENTIRELY BRITISH.

The Edison Swan Electric Co., Ltd.
PONDERS END, MIDDLESEX.
London and Provincial Depots.

TUDOR
ACCUMULATORS
CAN BE OBTAINED
ONLY FROM
THE
TUDOR ACCUMULATOR
COMPANY, LIMITED,
3, Central Buildings, WESTMINSTER, S.W. 1.
Telegrams: "SUBCONICAL, LONDON." Telephone: VICTORIA 816.
Works: DUKINFIELD, near MANCHESTER.

MICA & MICANITE
INSULATORS FOR EVERY DESCRIPTION OF ELECTRICAL WORK.
Contractors for Air Board, War Office and Admiralty Requirements
CUTTING AND GAUGING OUR SPECIALITY.
BEST QUALITY MICA ONLY.
'PHONE 4575 CENTRAL.
TELEGRAMS—"MICAYLOR, LONDON."
TAYLOR & PETTERS, LTD.,
40, HATTON GARDEN,
LONDON, E.C. 1.
(The Oldest Established Mica House in the country.)



THE
ARORA ELECTRIC FIRE
Has given universal satisfaction.
WHY? Because OUR patented Element is of HEAVY SECTION and has LOW Current Density, yet it GLOWS at a HIGH TEMPERATURE.
Low Price, Robust, Cheery, Economical.
Write for List E (Fires & Cookers) to Sole Manufacturers:
THE ARORA CO., Loughborough.
(Proprietors: Messrs. Bown & Co., Ltd.)

VULCANISED FIBRE.
In Sheets, Rods, Tubes, and Special Shapes.
Horn Fibre, Diamond Insulation, Press Board, Fuller Board, &c.
DIAMOND FIBRE TRADE MARK
DIAMOND FIBRE CO., LTD., 57, OLD ST., LONDON, E.C.

THE

# ELECTRICAL REVIEW.

VOL. LXXXIV. APRIL 25, 1919. No. 2,161.

## ELECTRICAL REVIEW.

Vol. LXXXIV.] CONTENTS: April 25, 1919. [No. 2,161.

| | Page |
|---|---|
| Arbitrary Rules | 457 |
| Rural Industries | 458 |
| France's Electrical Bill against Germany | 458 |
| Decline in German Export Orders | 458 |
| U.S.A. and S. American Trade | 459 |
| Siemens & Halske Works in Russia | 459 |
| National Electric System for Spain | 459 |
| An Electrically-driven Winding Equipment (*illus.*) | 460 |
| Erith's Municipal Kitchen (*illus.*) | 461 |
| Searchlight Equipment and Operation, by H. M. Goody (*illus.*) | 463 |
| New Electrical Devices, Fittings and Plant (*illus.*) | 465 |
| The Electrical Development Association | 466 |
| The Corrosion of Condenser Tubes | 467 |
| **Correspondence—** | |
| Rotor Currents of Slip-ring Motors | 468 |
| Telephone and Telegraph Line Construction | 468 |
| Is the E.P.E.A. Moribund? | 468 |
| The Definition of Electrical Resistance | 468 |
| **Legal** | 468 |
| **Business Notes** | 469 |
| **Notes** | 475 |
| **City Notes** | 478 |
| **Stocks and Shares** | 479 |
| **Market Quotations** | 480 |
| "Rules" Imposed by Electric Supply Authorities, by C. A. Baker (*concluded*) | 481 |
| Surface Condensing Plant for Large Power Stations | 483 |
| The Effect of Air and Water on Materials used in Engineering Work, by H. E. Yerbury | 484 |
| Planning a Works Research Organisation | 486 |
| The Wireless Compass (*illus.*) | 487 |
| New Patents Applied for, 1918 | 488 |
| Abstracts of Published Specifications | 488 |
| Contractors' Column ... Advertisement page | xxv |

## THE ELECTRICAL REVIEW.

**Published every FRIDAY, Price 4d.**

*The Oldest Weekly Electrical Paper. Established 1872.*

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

***OFFICE:—4, LUDGATE HILL, LONDON, E.C. 4.***

Telegraphic Address: AGREKAY, CENT., LONDON." Codes. A B C. Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

**Subscription Rates.**—Per annum, postage inclusive, in Great Britain, £1 1s. 6d.; Canada, £1 5s. 10d. ($5.80). To all other countries, £1 10s.

**FOREIGN AGENTS:**

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND N.Z.: Gordon & Gotch, Albert Street; Peter G. Tait, P.O. Box 524.
BRISBANE. Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c. Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: Peter G. Tait, 90, William Street; Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: Peter G. Tait, 273, George Street; Gordon & Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch 132, Bay Street.
WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "London City and Midland Bank, Newgate Street Branch."

## TO "ELECTRICAL REVIEW" READERS.

**We regret that recently a number of our readers have experienced difficulty in securing copies of The ELECTRICAL REVIEW. The reason for their disappointment is that our circulation is continuing to increase so rapidly that it is impossible for us to guarantee that any casual copies will be available after the hour of publication. In order to make sure of receiving one's copy regularly as issued, a definite order should be placed with a newsagent, or subscription should be sent direct to the Publishers, ELECTRICAL REVIEW, LTD., 4, Ludgate Hill, London, E.C. 4.**

## ARBITRARY RULES.

WE have often had occasion to point out that, with possibly a few exceptions (such as Glasgow and Manchester, which have obtained statutory powers), electricity supply authorities have no right to impose upon consumers "rules" relating to the technical details of their installations, and that, in fact, most of the conditions to which the intending consumer is required to subscribe, on pain of refusal to connect his installation, are entirely *ultra vires*. As long ago as 1899, when the subject of wiring rules was under discussion at the Institution of Electrical Engineers, Mr. C. H. Wordingham remarked that the power to enforce such rules was deficient; and in 1901, in a paper read before the Newcastle Local Section of the Institution, Mr. F. Broadbent exhaustively discussed the infinite variety of rules with which contractors were required to comply, pointing out that station engineers were addicted to issuing rules which might deter consumers, and which could not be enforced. In the article on this subject which is concluded elsewhere in this issue, Mr. C. A. Baker discusses the matter very fully, and shows how very liberally undertakers have construed their rights and privileges. We welcomed this article for two special reasons, which are set forth below.

We freely admit that in the early days of electricity supply, these local rules served a good purpose. Wiring practice was then slowly developing; authoritative standards were non-existent, and the jerry wireman had free play for his nefarious practices. In those days, say in the late '80's, we ourselves at times came across examples of cotton-covered solid wires of No. 8 or 10 B.W.G. laid in wood casing, with dry twisted joints, in installations carrying up to 100 volts; we have seen a gas-pipe melted and a fire started by contact with cotton-covered wires used to support a pendant lamp; wooden switch-bases, fuse-blocks, and lampholders, were in common use, and wonderful feats were accomplished with cotton tape, shellac varnish, and the indispensable Chatterton's compound. The famous Phœnix Fire Office Rules, first drawn up in 1882 by Mr. Heaphy, prolix, contradictory, and open to evasion though they were, nevertheless purported to establish a reasonable standard of quality for wiring and equipment, and held sway long after they had ceased to be the only, or even the best, code of rules; no doubt many of the local rules adopted by supply authorities in those days were based upon this code. But the conditions to which we have referred exist no longer. Wiring practice is now fairly well standardised, and in the Wiring Rules of the Institution of Electrical Engineers we have a code which represents the consensus of opinion of the best authorities on the subject, and which has been adopted by the Phœnix Assurance Co. itself, as well as by practically all the other fire offices in the country. As Mr. Baker shows, in many

cases the local rules embody ideas which have long been obsolete, and probably are not enforced even by their authors; if they must have a code of rules, they should adopt that of the Institution. But there is no longer the same necessity for supply authorities to play the part of consulting engineers and inspectors; the general standard of wiring is nowadays far above that of the last century, and if a reputable contractor is entrusted with the work, there is a reasonable presumption that it will be satisfactorily carried out, while if the guarantee scheme of the Contractors' Association is availed of, the presumption becomes certainty. We hold, then, that these local "rules" are not only illegal, but also superfluous, and therefore ought to be abolished.

But our second reason is, perhaps, the more important. We have seen how, in the early days, the manager of an electricity undertaking not only had to act as engineer to his own concern, but also felt it his duty to act as technical adviser and protector to his prospective consumers—and discharged that duty with the aid of a formidable code of rules which he imposed upon them by *force majeure*. Last week we pointed out that the halcyon days of the engineer, as such, had passed away, and that the business manager was now the man of the hour. We do not suggest that the engineer cannot adapt himself to the latter *rôle*; in many cases he has done so with conspicuous success. But the point is this: while the instinct of the engineer is, above all, to ensure a sound job, that of the commercial manager is to increase his output, and, therefore, to attract new customers to the mains. Hence it is incumbent upon him to remove all obstacles to the accession of new customers.

We put it to the business man that this array of rules and regulations acts "in restraint of trade," and is therefore doubly illegal, besides foolish. Take the case of the gas supply authorities—the contrast is amazing. Do *they* interpose a set of conditions and obstructions between the customer and his supply? On the contrary—the connection of a gas installation to the mains is so simple a process, so quickly and politely accomplished, and with such an obvious desire to give satisfaction to the consumer, that it is actually a pleasure to go through it. If any slight defect is noticed, do the gas-men "require" the consumer to have it put right, and inform him that a second test will cost him 5s. (an illegal charge)? No—they put it right themselves, on the spot; there is no circumlocution or delay—the gas suppliers are out to sell gas, and lots of it, not to play the part of jack-in-office.

On the other hand, if one applies for particulars as to the supply of electricity, one is informed that one may have it on the basis of *x*d. per unit "flat rate," or *y*d. and *z*d. on the "maximum demand" system, or £*a* per kilowatt and *b*d. per unit, or *m* per cent. of the rateable value + *n*d. per unit, or otherwise; and a different charge will be made for cooking and heating, and another for power if used; and the would-be consumer must observe a book of rules, and is liable to have his supply cut off (illegally), even without notice. Surely this is not "business," but its very antithesis.

A new phase in the history of electricity supply is opening before us. Let us cast away all hampering, unnecessary restrictions, and *welcome* the new consumer; make his path easy, and abandon the tradition which requires that he shall fight his way through the wire entanglements and pitfalls which have embarrassed him up to now. The supply undertakers are the servants of the public, not their masters.

**Rural Industries.**

The main object of the proposed National Electricity Scheme is, of course, the supply of cheap power to existing industrial centres. The first District Boards to be set up will be naturally those for areas where industrial towns are clustered together in a more or less homogeneous group, and the enlarging and cheapening of the power supply would chiefly be to enable existing manufacturers to meet foreign competition and to keep our place in the markets of the world. But, subordinate to this admittedly prior claim, there is a secondary demand for the attention of the new Electricity Commissioners in the need for the decentralisation of the industries. The tendency up to the present has been for industries to crowd together; they have, in fact, been obliged to do so. But such indiscriminate crowding of certain centres brings with it a number of social evils—slums, small and inadequate houses, no gardens, high rents, no open spaces for children, smoke, dirt, and so on. Now, when a cheap supply of power is made available in the country districts, a good number of industries could leave these crowded centres altogether and work equally well in surroundings which offer every advantage of health and well-being to their employés. This point was dwelt upon in a paper written by an engineer some time ago on the water power of the country, and used legitimately as an argument for the utilisation of such source of power. But it applies much more strongly in the case of electric power, which can choose its locality, as favourable to rail, canal, or other facilities. The only disadvantage of thus decentralising would be, from the electric supply point of view, the cost of trunk mains and the losses of energy in transmission. But these, after all, are merely matters of £ s. d., and negligible in face of the pressing industrial and social problems which decentralisation would help, at least, partially to solve. Even if public money were spent, the State at large would benefit.

---

**France's Electrical Bill Against Germany.**

M. Louis Dubois recently submitted to the French Chamber of Deputies a report on behalf of the Budget Commission, in connection with the Bill dealing with the reparation of damages caused by the enemy during the war. The report discusses in detail the extent of the damage to various industries. In the case of electrical and mechanical engineering works, which represented a total working capital of £80,000,000 in 1914, the works have been destroyed in the proportion of 90 per cent. The machinery and plant were worth £18,800,000, and as prices have almost trebled in the meantime, the loss under this heading amounts to £50,760,000. The raw materials and manufactured products which were removed or destroyed, are stated to represent a present value of £54,000,000. It is estimated that the losses on working, due to six years of enforced stoppage, amount to £34,200,000, whilst the damages to buildings are computed at a further sum of £16,800,000. Dealing with the electricity supply works, the report states that 80 per cent. of the machinery and plant, which was valued at £6,000,000, has been destroyed, and as cost prices have risen about three-fold, the loss works out at £14,400,000. It is calculated that the losses on the working capital of £7,920,000, due to the stoppage of French working, amount to £5,720,000, whilst the damage to buildings is placed at £2,520,000.

---

**Decline in German Export Orders.**

The first issue of the monthly circular published by the Siemens group, recently pointed out that one-third of the production of manufactures by the German electrical industry was exported in normal times, and that one-third of the staff and workmen would have to find other employment if foreign orders were not received. In the third issue of the circular, it is now stated that orders from transmarine countries probably cannot be reckoned on in the near future. Not only so, but the arrival of orders from the European countries still open has dangerously declined. The orders received in

September and October, 1918, were far above the average of the preceding year. The circle of foreign customers, presumably, had been induced to place large orders at that time in consequence of the obviously approaching end of the war. With the starting of the revolution, however, the receipt of orders rapidly decreased, and the economic and political conditions in Germany have made it appear to other countries advisable to place their orders elsewhere.

**U.S.A. and S. American Trade.**

Leaders of manufacturing and export activity in the United States are displaying a certain anxiety regarding the future of their trade in South America. They recognise that, although handicapped during the latter part of the war by lack of freight and by a certain degree of difficulty in manufacturing, the conditions under which they have been operating in the Latin-American markets have, on the whole, been favourable to them. They recognise, moreover, that every possible outlet for their production and manufacture of goods must be assiduously exploited if their labour and their plant are to be kept occupied to the extent desirable.

The United States Commercial Attaché in Buenos Aires has been discussing the question whether his country will hold its present trade in the Argentine Republic. He does not expect that the United States will continue to supply Argentina with the greater part of its imports of textiles, glass-ware, china-ware, drugs, &c., but that it will do so to an increasing extent as regards iron and steel, machinery, automobiles, furniture, &c. British exporters might well note that his confidence is based largely upon the fact that an intelligent effort is being made by American manufacturers to supply the goods which meet the tastes and desires of the Argentine consumer. The United States firms will now reap the advantage of branches in the Argentine of their banking institutions, and, further, as regards representation, of having taken the right and sensible course of establishing their own branch houses or private agencies there to conduct their sales. Among those of particular interest to electrical and allied trades may be mentioned industrial machinery generally, including printing machinery and shoe manufacturing machinery, iron and steel goods, rubber goods, hardware, and lubricating oils. Furthermore, large Argentine concerns, many of them controlled by European capital, are locating permanent buyers in the United States. On the other side of the picture, however, the Commercial Attaché recognises that shipping facilities are turning again more in favour of European countries, that greater effort must be made in the United States to train men for taking up appointments abroad, and that better plans must be adopted by which the foreign buyer may be protected against the unreliable commission agent or manufacturer, because it is admitted that American trade has been harmed in South America during the past few years by the questionable actions of certain firms. Another direction in which the Commercial Attaché considers action is needed is the matter of investment of American capital in South American enterprises.

**Siemens and Halske Works in Russia.**

A report on the economic effects of Bolshevism in regard to the Russian Siemens & Halske Co. has just been issued by the Siemens group in Berlin from information furnished by a member of the staff of the former company. The report states that the company's works at Petrograd employed about 2,000 workmen in 1916, as compared with 700 in the last year of peace. In the autumn of 1915 it was decided, at the request of the Government, to build new works at Nishni-Novgorod for the employment of 2,000 men, and the expenses were defrayed substantially out of instalment payments made on account of large State orders. Owing, however, to the difficult transport conditions, delay took place in the delivery of the machine tools ordered in the United States, and it was, therefore, only possible to supply the first manufactures to the Government in the spring of 1917, or six months later than had been foreseen. In January, 1917, the Government of the Czar made a decisive change in the organisation of the company and that of the Siemens-Schuckert Co. A new company, for instance, was to be formed, with a capital of 25,000,000 roubles; the Government was to take over 35 per cent. of the shares, and 65 per cent. was to have been placed at the disposal of financial circles in Russia and in those of Russia's allies. The attempt to allocate the 65 per cent. in this manner was not successful, and, as a consequence, the only decision reached was to appoint a Joint Administration, composed of representatives of the Government and of the old management. The revolution occurred in March, 1917, and simultaneously with it arose demands of the staff and workmen for increases in wages and reduction in hours. The production declined rapidly, and fell in a few months to scarcely half the output prior to the revolution. After the revolution in October, when the Bolshevists gained control, the working capacity almost entirely ceased, and the production fell in 1918 to about one-tenth of that in 1916. New orders stopped with the end of the war; the old contracts were carried out in part, and partly cancelled or postponed; whilst private orders are entirely absent. The prices have risen enormously for whatever work has to be regarded as essential. For instance, a Morse apparatus which was sold for 157 roubles in 1914 was priced at 1,500 roubles in 1918; and a Baudot apparatus advanced in the same years from 4,000 roubles to 36,000 roubles. It was impossible from the middle of 1917 to pay the wages and salaries out of the proceeds of sales, and the Government had to make advances to the company to defray the further growing wages and salaries. In the autumn of 1918 the company was indebted to the Government for many millions of roubles without any prospect existing of these sums ever being repaid. The nationalisation of the undertaking was resolved upon in September, 1918, and the remaining 25 officials and 80 workmen became State officials, who are not able to do much more than maintain an inventory.

**National Electric System for Spain.**

A Royal Order published on Dec. 31st, 1918, provides that, as soon as possible, a permanent Spanish Electric Commission shall be formed under the direction of the Ministry of Public Works. This Commission shall report on the following points:—

1. The possibility and practicability of the construction by the State, directly or indirectly, of a national system for the distribution of electrical energy.
2. The maximum extension possible of such a system.
3. The approximate cost of such a system calculated on a basis of relatively normal prices, or with copper at between £70 and £80 sterling per ton.
4. The possibility of the State supplying the capital to be thus employed, or guaranteeing its interest, taking tolls on the energy transmitted, and how much this toll should be, or any other means of financing the system deemed preferable.
5. The possibility of a uniform pressure and the means to secure it.
6. The basis on which a law should be drawn up in connection with the foregoing.

The Director-General of Spanish Commerce, Industry, and Labour states that it is of transcendental importance to Spanish industry that it avail itself of the electrical energy that the country is capable of producing. A great deal has been done to this end, but there are still many problems to be solved in connection therewith. Water power is distributed throughout Spain, but only companies with large capital can confront the expense of producing sufficient power to electrify railways. While there is water power in some parts of Spain supplying energy a hundred miles away or more, there are also tracts where no such power exists. Climatic conditions vary largely, as does the flow of water in the rivers. For example, the proportion of water in the Guadalquivir in summer as compared with winter is 1 to 1,000; and, on the other hand, there are rivers on the slopes of the Pyrenees which are dry in the winter and fullest in August, when the snows are melting. Coal production has been brought to a prosperous condition during the war, but the problem of its transportation remains unsettled. Although general electrification is difficult, the undertaking in Spain is regarded as well within the realm of possibility.

# AN ELECTRICALLY-DRIVEN WINDING EQUIPMENT.

Recently there has been put to work at Kilton Collieries an interesting example of an electric winder representing the latest practice in geared A.C. winding plant. The winder has been designed to suit the following conditions :—

| | |
|---|---|
| Depth of shaft ... ... | 720 ft. |
| Net load of stone ... ... | 3·5 tons |
| Weight of cage and chains | 3 tons |
| Decks per cage ... ... | 1 |
| Tubs per cage ... ... | 2 |
| Weight of one tub ... | 0·65 tons |
| Output per hour ... ... | 180 tons (iron stone) |
| Time of winding ... ... | 45 sec. |
| Decking interval ... ... | 15 sec. |
| Total time each wind ... | 60 sec. |
| Drum, cylindro-conical ... | 11-ft. to 15-ft. dia. |
| Turns on small diameter... | 6 (three dead) |
| Turns on scroll ... ... | 4 |
| Turns on large diameter... | 9·7 |
| Drum speed ... ... | 27·6 R.P.M. |
| Rope diameter ... ... | 4½ in. circum. |
| Maximum rope speed | ... 1,300 ft. per minute |
| Motor rating ... ... | 370 B.H.P., 3-ph., 40 per., 2,750 v. |
| Motor peak ... ... | 440 H.P. |
| Motor speed ... ... | 255 R.P.M. |
| Ratio of gearing ... ... | 9·25 to 1 |
| Supply ... ... ... | 3-ph., 40-per., 2,750 volts |
| Auxiliaries... ... ... | 3-ph., 40-per., 440 volts |

The winder was built to replace a beam-type engine with overhead drum, which, although somewhat expensive to run as regards steam consumption, was, on the whole, free from costly repairs. Latterly, however, this engine developed defects, and its replacement became increasingly urgent. It was imperative that the steam winder should remain on duty until the last possible moment, and that the change-over should take place during a week-end. This was successfully accomplished, and the electric winder started work promptly on the Monday morning without any hitch. The new winder house is built immediately behind (relatively to the head gear) the old engine house; this incidentally resulted in the distance between the head sheaves and drum being increased in the rope plane, thus favourably affecting the angling of the ropes.

By this arrangement of buildings, the rapid transference of the ropes to the new drum, and the clearing of a way for them through the upper part of the old engine house was greatly facilitated, whilst, at the same time, no alterations whatever to the head sheaves were necessary.

The induction motor (figs. 1 and 2) is geared to a spur wheel on the drum shaft, the driving pinion being mounted on an extension shaft supported by two bearings, the connection to the latter shaft being made through a flexible coupling of the "pin" type. The gearing is of the double-helical variety, and is mounted in a dust-type gear box where the spur wheel dips into an oil bath. This wheel, which is about 10 ft. diameter, is split in halves for the purpose of facilitating its erection, and also removal of the drum shaft should this ever be necessary.

In order that high peaks may be eradicated and the winding cycle equalised to a great extent, a cylindro-conical drum has been designed and fitted. It is, perhaps, unnecessary to point out that the shorter the decking period can be made, the more efficient becomes the winding cycle. The decking period in this case is 15 seconds. Further equalisation is not called for in this case, especially as the supply company has installed within a short distance of this particular colliery, a synchronous motor for correction of the power factor in the district.

The drum brakes are operated by means of a compressed air engine which raises or lowers the main brake lever which is of the usual weighted type.

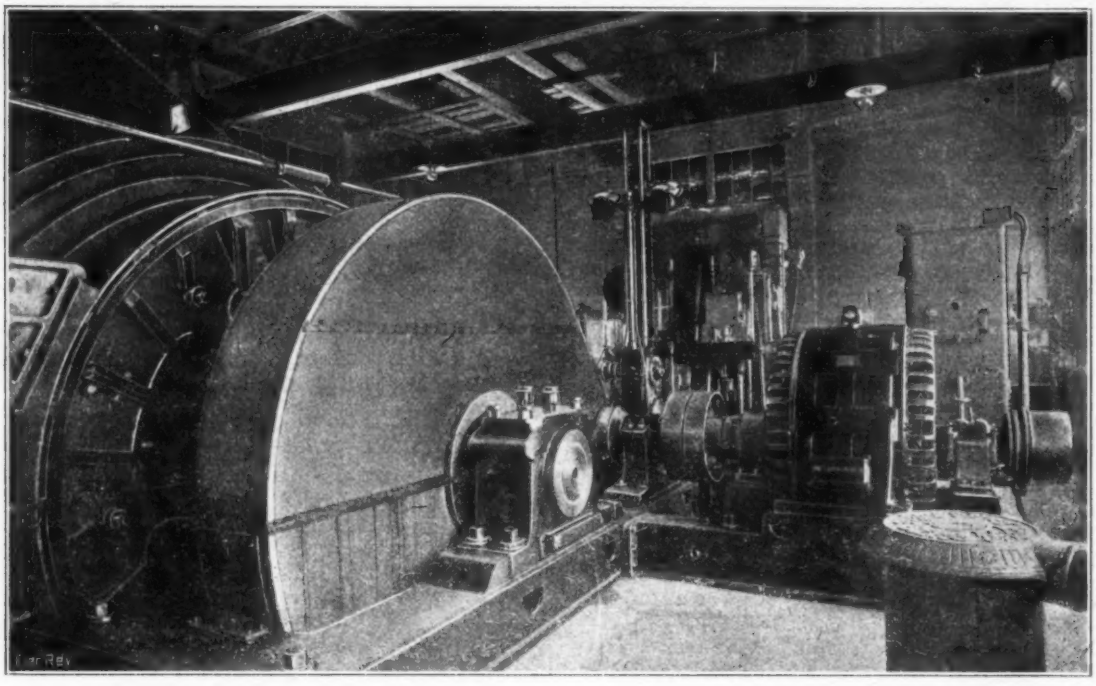


Fig. 1.—General View of Winding Plant.

In the event of operation of any of the emergency trips —for instance, when an overwind occurs—a solenoid-released trigger causes the main brakes to go into the "on" position immediately. The interlocks are such that the brakes remain in the "on" position until the emergency condition is restored to normal and the power put on again.

The air compressor for the brake engine is of the two-stage type, driven by a 10-H.P. motor, and is supplied from a three-phase, 440-volt, auxiliary transformer, which also supplies the solenoid and controller pump motor.

The driver's platform (fig. 1) is of such a height as to give the operator a clear view of the whole plant under his care, a condition which is, perhaps, too often overlooked. The motor is controlled by a liquid controller of the weir type, fitted with oil-immersed reversing switches.

During the time the controller is in circuit a continuous flow of electrolyte is pumped into the upper tank, returning over the sluice gate into the lower tank. The movement of the

operating lever throws the reversing switch in one direction or the other, according to the direction of rotation, and at the same time raises the sluice gate. This causes the level of the liquid in the upper tank to be raised, and, consequently, the resistance between the electrodes is decreased. When the operating lever is returned to the "off" position, the sluice gate is lowered again, and the level of the resistance liquid is lowered, thus increasing the resistance in the rotor circuit. Just before reaching the "off" position, the primary circuit is opened on the reversing switch. When it is desired to run at a slow speed, the sluice gate is lowered to an intermediate position, thus increasing the resistance as found necessary. Owing to the fact that the resistance liquid cannot follow the raised sluice gate faster than the pump can deliver the liquid into the upper tank, a certain minimum accelerating period of the motor must be adhered to, although it is possible to obtain a longer acceleration period. The acceleration period is adjustable within limits by means of a stop-valve in the delivery pipe of the pump. The system avoids unnecessary peaks. When winding men, it is often necessary to adopt a different rate of acceleration than when winding stone, and the necessary adjustment may be very quickly effected.

The reversing oil switches are fitted with safety interlocks, which are so arranged that the oil containers may not be removed without tripping the main oil switch.

An electric overspeed preventer device has been fitted, which in this case consists of a D.C. series-wound generator, chain driven from the motor extension shaft, and arranged to deliver its output through a bank of resistances, a relay, and an ammeter. These resistances are inserted into the generator circuit in a number of equal steps, each of which corresponds definitely to a certain number of completed turns, or fractions of turns, of the main drum during acceleration. The resistance inserted will only maintain the current in the small series-generator circuit constant up to full speed, provided the generator speed or drum speed rises at a definite set rate. Put in another way, the drum speeds as taken at short intervals must only reach certain values relative to the position of the rheostat. Should it exceed these, the resistance previously inserted would be insufficient to keep the current through the relay within a safe limit. In such a case, the result would be that, owing to too high a rate of acceleration having been permitted, the relay would trip the main oil breaker, and the equipment would be temporarily shut down. Similarly, when approaching the end of the wind, the operator must not neglect to slow down at a point in the wind for which the device is set, otherwise the resistances will be cut out more rapidly than the generator speed and volts drop, which would cause the excess current to open the breaker. It is, therefore, obvious that a winder fitted with this device must always be driven to diagram, and in such a manner as will ensure the maximum of safety, the driver being compelled to follow a definite accelerating and decelerating curve within safe limits.

The device acts as an efficient overspeed preventer during the constant full-speed running time of the winder, and also in the case of a loaded cage being lowered on the brakes only, and beyond "safe" speed.

The overwind switch is of the friction-driven type, being fitted with a flexible steel-rope drive working in a grooved pulley, mounted on the switch spindle. The rope is attached to a lever, which is struck when an overwind occurs by tappets provided on the depth indicator. The flexible cord pulls the switch open and shuts down the winder, but as the drive on the grooved pulley is by friction only, the switch may be reset by hand speedily, the rope slipping in the groove to permit this. It will, therefore, be perceived that should the winder be started in the wrong direction following on an overwind, no risk is incurred as the switch will always shut down the winder when the cage has moved less than 1 in. upwards.

The British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park, supplied the complete winder, being principal contractors to Messrs. Bell Bros., Ltd., the proprietors. Messrs. Robey & Co., Lincoln, were sub-contractors for the mechanical parts.

## ERITH'S MUNICIPAL KITCHEN.

Thursday, April 10th, witnessed the opening of Erith's Municipal Kitchen and Restaurant, the ceremony being performed by Mr. T. G. Jones, Director of National Kitchens, of the Ministry of Food, in the presence of a large and representative gathering.

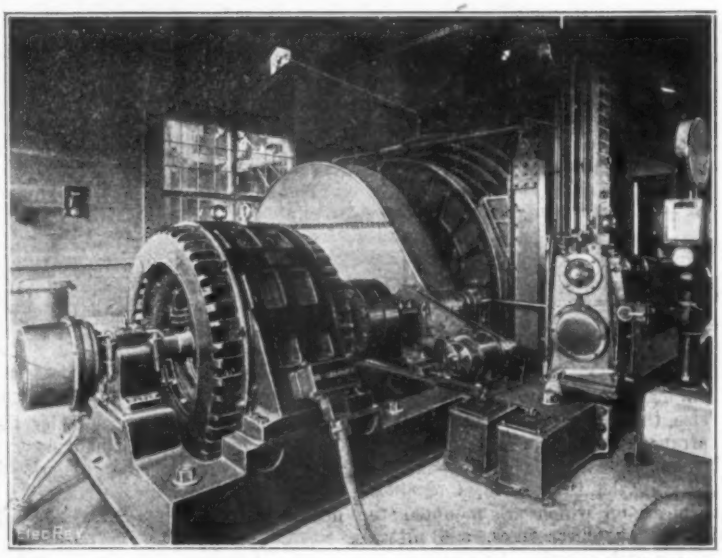


Fig. 2.—370/740 h.p. Westinghouse Induction Motor Driving Winder.

Occupying, as it does, a most central position, the new building bids fair to prove a boon to the public in many respects. The restaurant, which is under the capable management of Mr. and Mrs. J. Harle, of Newcastle-upon-Tyne, who have a wide experience in catering for large institutions and munition canteens, will supply meals cooked under the most hygienic conditions by electricity, at prices which come within the range of the most limited pocket.

The arrangements made for supplying meals for home consumption will enable a large number of persons to be served in the shortest time, separate entrances and exits being provided. Meals for consumption off the premises can be obtained from 11.30 a.m. daily, and dinners for consumption on the premises will be served daily from 12 noon till 2 p.m. Teas will also be provided each afternoon.

The room provided for the consumption of meals on the premises has been made as attractive as possible, the decorations are effective, whilst the general surroundings should help to contribute to the comfort of patrons.

The building was erected by the Erith District Council, the Government lending the money—£4,000—free of interest, to be paid in a certain time. The Kitchen is constructed of glazed bricks with vitrous tiled floor, and the restaurant of asbestos sheeting, while the roof is covered with asbestos slates supplied by the British Fibro-Cement Works, of Erith. The sinks and other kitchen equipment were supplied by the Stains Kitchen Equipment Co. Mr. Harold Hind, surveyor to the Erith Council, was the architect responsible for the plans, the building work being admirably carried out by Messrs. H. Friday & Sons, contractors, of Erith.

The whole of the electrical cooking apparatus was supplied

and erected by Carron Company, of Carron, Stirlingshire, the work of erection being carried out under the supervision of its London representative, Mr. C. McKinlay, A.M.I.E.E.

Details of the equipment are as follows :—One treble-oven range comprising one single, and one double oven, the dimensions of the single oven being 22 in. by 20 in. by 22 in., and that of the double oven approximately twice the size, the heating elements being separately controlled and arranged for a wide range of heat regulation.

Fig. 1.—Treble-oven Range and Hot Closet.

The range is fitted with a continuous crown-plate with skirting at the back, and is complete with a separate switchboard on which are mounted the necessary rotary indicating switches, fuses, and pilot lamps for each circuit. The hob contains three large and six small rectangular boiling sections, the total maximum loading of the range comprising the ovens and boiling sections being 33 kw. A view of the range is seen in fig. 1.

The second item is an electrically-heated hot closet 6 ft. long by 2 ft. 10 in. high by 2 ft. wide, constructed of cast-iron, with a plain polished top, and with mouldings all round, and panelled back and ends, fitted with sliding doors to the front, and a perforated shelf in the centre, as seen in fig. 1. The heating elements are arranged at the back and ends of the apparatus, the controlling switches and fuses being mounted on a switchboard fixed at the end of the hot closet. The total maximum loading of the appliance is arranged for 4 kw.

The third item comprises three 30-gallon boiling pans, consisting of tinned-copper inner pans, with galvanised outer cases, cast-iron tops, bases, and legs, double-cased, and packed with heat-retaining material, complete with hinged lids and large-bore draw-off taps. These pans are shown in fig. 2. The total maximum loading of each pan is 12 kw.

Fig. 2.—Boiling Pans and Steaming Ovens.

Two electric steaming ovens make up the fourth item, each oven measuring 17½ in. wide × 28 in. high × 23 in. deep inside. The construction consists of a sheet-steel outer case and galvanised iron interior, with accommodation for five galvanised wire baskets, and cast-iron top, base, legs, and door, with a drip gutter in front.

The water pan in the bottom of the oven is heated by means of elements arranged for various heat regulations, the whole being controlled by rotary indicating switches mounted on a separate board complete with fuses and pilot lamps. The bodies of the ovens are lagged with heat-retaining material, and a cast-iron supply cistern with ball valve is arranged at the side, as seen in fig. 2. The maximum consumption of each oven is 5 kw.

One double electric grill, as seen in fig. 3, forms the fifth item, consisting of two compartments, the internal dimensions of each being 16 in. by 17 in., complete with brander, porcelain enamelled soleplate, and drip tin, each compartment being independently controlled by a separate switchboard. The total maximum loading of the grill is 8 kw.

Two cast-iron electric fish fryers are provided, each measuring 20 in. by 18 in., by 4½ in. deep, mounted on four substantial feet, complete with separate controlling switchboard, also shown in fig. 3, comprising rotary indicating switch, fuses, and pilot lamps, the maximum loading of the apparatus being 4·8 kw. each.

The last item but one comprises four electrically-heated hotplates, the dimensions of each being 17 in. by 9 in., mounted on four legs, and being complete with a rotary controlling switch fitted to the front of the apparatus. The maximum loading of each hotplate is 1·2 kw.

The eighth and last item is a six-gallon polished copper water boiler fitted with a lift-off cover, large bore draw-off tap, and controlled by a three-heat switch mounted on a separate switchboard ; the unit is complete with fuse and pilot lamp, the total maximum loading being arranged for 3 kw. The whole of the apparatus is balanced on the three phases of the supply main, and the pilot lamps of each separate piece of apparatus are painted a distinct colour, according to which phase they are connected. Three ammeters, also painted with the corresponding phase colours, are provided and placed in a prominent position, as shown in figs. 2 and 3, so that the total loading on each of the three phases may be kept under observation, and the balance adjusted

accordingly. The electricity supply is taken from the mains of the U.D.C., being three-phase, 50 cycles, at 350 volts. The cables are lead in through ducts under the kitchen floor, and terminate in cast-iron pipes running up the back of each piece of apparatus.

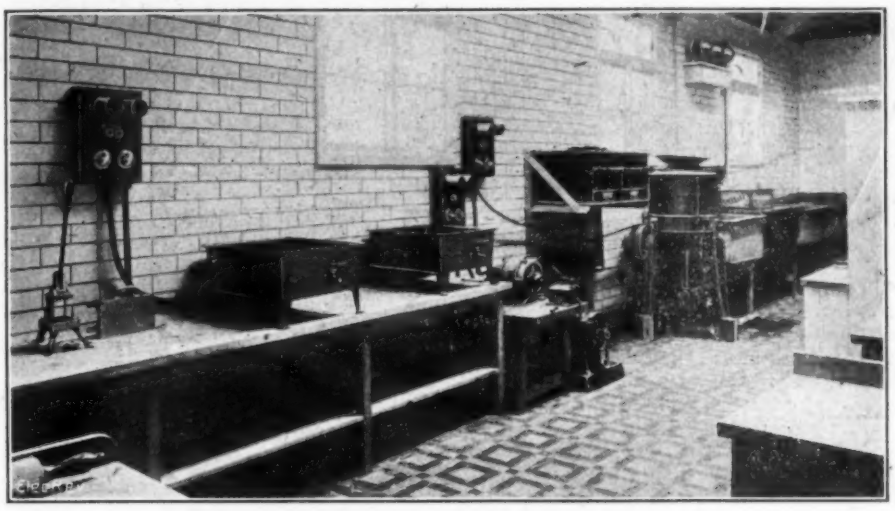


Fig. 3.—Auxiliary Electrical Apparatus.

In addition to the apparatus already mentioned, an electrically-driven mincer and potato peeler are provided, both being arranged to be driven by the one motor as seen in fig. 3.

In conclusion, our thanks are due to Mr. C. McKinlay for supplying the data set out above, and the U.D.C. for an opportunity to be present at the opening ceremony.

## SEARCHLIGHT EQUIPMENT AND OPERATION.

By HUGH M. GOODY.

Having considered in a previous article* the principal apparatus and methods employed in searchlight work, it may be of interest to deal slightly more fully with one or two points regarding the electrical equipment in use in an overseas searchlight section, and the staff organisation.

*Equipment.*—The generating equipment consists, on stationary lights, of small petrol-electric sets of the "Aster," "Simplex," and similar makes for the 60-cm. diameter projectors, and of somewhat heavier sets—"Keighley," "Dorman," and others—for the 90 and 120-cm. diameter lights. Up to the early part of last year these stationary sets—sometimes of quite unwieldy design—were extensively employed for mobile work also, but when, in March, we were compelled to retreat in various sectors, the disadvantages of such heavy plant within comparatively short distances of the line became overwhelmingly evident. Subsequent to that date, therefore, nearly all mobile sections were fitted out with proper mobile equipments. These consisted of either "Tilling-Stevens" or "Dennis-Stevens" petrol-electric lorries. These lorries not only provide the power for the light, but when on the move carry the projector and crew, together with their kit and gear. The interior of the lorry is fitted up with a switchboard carrying a main switch, ammeter, voltmeter, and suitable fuses. Alongside the switchboard is mounted a substitutional resistance which provides a load when the arc is not in use. An automatic cut-out is fitted on the switchboard, so that as soon as the arc is struck the resistance is cut out of circuit. The voltage at the switchboard terminals is kept as near 80 volts as possible.

The lorry and the projector emplacement are usually some 200 yards apart, to prevent the noise of the engine interfering with the work of the lamp crew, and to transmit the current to the projector about 250 yards of C.T.S. cable is provided. This is so arranged that there is a voltage drop of 20 volts between the two points, giving a pressure at the lamp terminals of 60 volts. The resistance of the cable provides the necessary steadying resistance for the arc circuit.

In the projector emplacement is a switchboard fitted with voltmeter, ammeter, and switch. The arc of a 90-cm. diameter projector is usually run at 60 volts and 120 amperes are maintained. Careful adjustment of the carbons before dark is essential, so that there shall be no unsteadiness or flickering of the arc while in action. The lamp must also be focused, at any rate after each alteration of the carbons, to ensure that the positive crater is exactly at the focal point of the mirror; otherwise, of course, the beam will not be parallel.

A very important consideration involved in the arc-length is the shadow cone cast by the negative carbon, and it is necessary, if the best results are to be obtained, that this shadow cone shall be kept at its minimum value.

Theoretically, of course, to give a parallel beam, the light must be a "point source." This is, naturally, not a practicable possibility, even if the source be considered as the positive crater, and much less so when it is remembered that the whole of the arc is to some extent an illuminant. The result is that

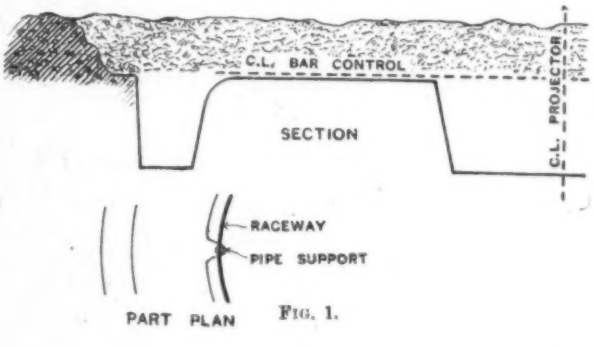



Fig. 1.

quite a large proportion of the rays reflected by the mirror are divergent instead of parallel. These rays are thrown on to the inside of the projector barrel, and reflected thence out through the front screen. They evidence themselves as a widely diverging cone of light apart from the main beam, lighting up the ground around the projector. It will be understood that this is very undesirable, and several methods have been adopted to prevent its occurrence. The latest and most successful consists of a number of concentric rings of sheet iron arranged outside the front screen of the projector,

* Electrical Review, February 28th, 1919.

The number, diameter, and depth of these concentric rings are so arranged that no ray except a parallel one can pass through them.

The telephones in use for searchlight work are of several types. For local work, such as communication between the spotters and the projector controller, a combined "buzzer" and speaking set is often used, but for other work, ringing sets of various types are employed.

For front-line defences, insulated ground lines are generally used, and provide plenty of work for the would-be fault-finder. Since these lines are laid across streams, hedges, bridges, on poles over roads, and so on, and since, moreover, "faults" always seem to occur at night, the man who is chosen to repair searchlight telephone lines does not usually consider himself lucky. A lineman has a little better time in back areas, where overhead lines are in use, since here, even in the dark, he can, with the aid of a torch, usually localise any breaks or shorts. If, however, this back area happens to be under shell fire, overhead lines may prove a source of considerable trouble. It is really marvellous what a number of faults will be caused by a comparatively small amount of shelling. Of course, much of the damage is due to the force of explosions in the neighbourhood of the wires, but it is surprising how often poles and wires are actually hit by flying particles; being such relatively small things, one would have thought they would surely have been missed. However, better damaged telephone lines and poles than other things!

*Organisation.*—The unit of the searchlight personnel on anti-aircraft work of the Royal Engineers is the section which may consist of either 20 or 28 members, according as it is responsible for the operation of two or three lights. The crew of a "light" consists normally of eight men, two of whom are N.C.O.'s. For the section there are in addition an officer, batman, A.S.C. driver, and a staff-sergeant mechanist; the duties of the last are purely technical. The discipline and organisation of the section are in the hands of the two (or three) N.C.O.'s in charge of the lights, the senior of whom is a sergeant.

The control of these units for fighting purposes is guided by two main principles. If the anti-aircraft defence of some base town, ammunition dump, railway works, or other important point is in contemplation, it is usual to adopt what is termed the "group" system. Here, all searchlight stations are connected telephonically—generally by overhead lines—to the anti-aircraft gun stations with which they are co-operating. These gun stations are in turn connected to "control" headquarters, which usually coincides with the battery headquarters of the artillery. The "controls" can, of course, be connected to any point on the army telephone system, so that a complete system of communication is established. By this means, warnings and orders can be transmitted from one A.A. station to another, no matter how distant from one another they may be, and the general policy is for front-line defences to warn all the rear defences over which enemy aircraft would be likely to pass. Notwithstanding this, a constant look-out is kept by each station individually, the crew of eight men performing this duty, as well as providing three men for duty on the generating set, throughout the night.

For front-line defence, each station is usually entirely independent, though local telephone communication with the gun station may be provided by means of insulated ground lines in cases where the conditions allow of it. In anything approaching mobile warfare, however, telephonic communication of any kind is very difficult, and local communication is usually provided by means of "runners."

The two problems which confront the searchlight operator are, first, to locate, and then to hold his "target." By constant application a man may become very efficient at locating aircraft without any external aid; two main devices are, however, now in use to aid the naked eye and ear, the first being specially arranged binoculars, and the second an apparatus termed a "sound locator." The first of these is designed for use on moonlight or starlight nights, when it has been proved that, by the use of ordinary binoculars it is quite possible to discern aircraft without any artificial illumination. The difficulty, however, has been that, to direct the searchlight beam on to the right spot, the eyes have to be taken away from the binoculars, and the target is consequently lost. To overcome this, the binoculars are mounted on a post on a level with the operator's eyes. These binoculars are free to rotate on either a horizontal or a vertical axis, and attached to them is an open sight as well as two pointers; the latter, in conjunction with two graduated scales, give horizontal and vertical readings in degrees. A "reader" accompanies the spotter, and directs the beam either by means of the sight or by calling out bearings and elevations.

The "sound locator" consists of four trumpets, two in line vertically and two in line horizontally. To understand the action of these it is necessary to appreciate to some extent the operation of the human "sound locator." If a sound is coming from the north, and the head is turned, say, east, the sound waves emanating from the source of sound will not reach the two ears exactly simultaneously; in this case they will reach the left ear slightly earlier than the right; this is not the whole theory, but will serve our purpose. To locate the source of sound, the natural action is to turn the head slowly to the left until a perfect balance is obtained. Our perception of vertical differences—*i.e.*, whether the sound is at an angle of, say, 15 deg., or one of 60 deg.—is much less acute, but it is effected by a similar balance in reference to the bones of the head. The four trumpets in a sound locator merely magnify these differences, and so enable a greater degree of accuracy to be obtained. Officially they work to an accuracy of 3 deg. or less, though much depends on the operators, of whom there is one to each pair of trumpets. Here again, it is observable that better results are obtainable in a horizontal plane than vertically. It will be obvious that the point located by this means is the point from which the sound emanated, and to locate the actual aeroplane allowances must be made for the speed and direction of its flight.

Once the target has been located by the spotters, the problem is then to hold it, and to do this it is necessary that it shall be constantly visible to the projector controller. With the "bar" type of control referred to in a previous article, the operator is some 12 ft. from the projector itself, and it has been found that with the target at normal distances, the angle between his line of sight and the line of the beam is sufficient to enable him to see the target if it is kept on the "near" edge of the beam; that is to say, since he is on the right-hand side of the projector, the target must also be kept on the right-hand edge of the circle of light. If the 'plane is travelling to the left and tending to enter the field of illumination, this is a comparatively easy matter, but if the machine is travelling to the right and tending to leave the field of light, the utmost skill is necessary to hold it in this position without losing it. The projector controller is provided with a telescope fitted to his control bar, to aid him in picking up and holding targets.

The methods of searching and holding given above apply to searchlights when used in conjunction with A.A. artillery, but lately searchlights have been much used as an aid to defensive aircraft patrols. For this purpose a constant patrol of small fighting 'planes is maintained, and the lights in conjunction with which they are operating are arranged in groups of three. Several lines of searchlights are

used, and on hearing enemy aircraft, the front line opens out, and, by means of the sound locator, "lays" on the sound as accurately as possible. Each small group of three lights arranged triangularly, endeavours to indicate as correctly as possible the position of the enemy aircraft, but makes no special effort to pick them up with the beam. When the defensive planes have, by means of the directing searchlight beams, located the enemy aircraft, a prearranged signal is given, on seeing which all lights except those which would illuminate the target from the front either shut down or get to work on some other target. In the event of the target not having been located before it has passed over the front-line lights, the second line takes on the duty of indicating the position of the enemy aircraft, while the front line is at liberty to "search" in the ordinary way.

A recent innovation in searchlight equipment is the machine gun, which is mounted on the control bar near the projector. This is provided as a defence against the fighting planes which accompany enemy bombing squadrons, and whose duty it is to give special attention to A.A. guns and lights. This gun is of little use, however, mounted on the control bar as it is, if the enemy planes come very low, since it cannot be moved independently of the projector, and the projector controller 12 ft. away cannot move the projector and gun round fast enough to keep pace with the aircraft. Nevertheless the Lewis gun is a very acceptable possession for a searchlight crew, who are otherwise defenceless.

All times and observations are carefully recorded by the telephonist, and essential reports are made over the telephone to "control" from time to time. The records of bearings and elevations, taken in conjunction with approximate estimates of the height of the planes, enable a track chart to be plotted of the course of the aircraft. In this way fairly reliable data are arrived at with regard to methods and objects of attack, and the whole defensive system can be kept up to date and capable of coping with any fresh developments on the part of the enemy.

With regular tours of duty, frequent "alarms," telephone systems and plant to maintain during the daytime, to say nothing of fresh emplacements to dig as the light is moved about, it will be seen that the time of a searchlight crew is amply occupied, and that everything is done to render the system of anti-aircraft defence as efficient as possible.

## NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

*Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.*

### Electric Valve-Closing Apparatus.

Messrs. Thacker, Bell & Co., Ltd., of 44, Leadenhall Street, E.C. 3, are introducing an electric valve-closing device patented by Mr. James Tate, of Bradford, which effects its purpose by a very simple method. It is intended to enable engines, turbines (steam or water), and other motors to be stopped instantly at will, from any distance, or automatically, in case of over-speed, at the same time destroying the vacuum of a steam engine to prevent water from backing up to the cylinders.

In applying the device to an engine, the wheel, spindle, and cover of the stop valve are replaced by a new wheel, spindle, and cover, with which is combined the stop apparatus. This consists of a powerful spring, controlled by an electrically operated pawl; when the stop valve is opened, the spring coiled round the spindle is put under tension just as a watch is wound up, and by pressing a button which closes the circuit of an electromagnet, the spring can be released, closing the valve. A pair of small governors, driven from the main shaft, effects the same operation automatically in the event of the speed becoming excessive. An air valve, connected to the condenser by tubing, and to the engine side of the stop valve, simultaneously opens automatically, admitting air to the condenser, and thus destroying the vacuum.

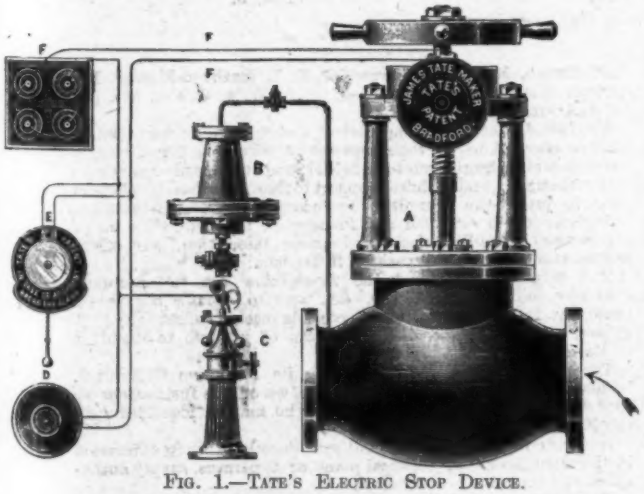



Fig. 1.—Tate's Electric Stop Device.

A, apparatus attached to stop valve; B, patent air valve; C, auxiliary governors; D, open push for daily use; E, safety push for use in workrooms; F F F, Leclanché battery and wiring.

The apparatus, which is illustrated in fig. 1, thus provides for the quick stopping of the engine in case of emergency, saving life or preventing personal injury, as well as avoiding damage to machinery through accident or overspeed, secures the safety of the engine and reduces the insurance premium thereon, and protects the owner against the operation of the Employers' Liability Act. A small primary battery suffices to actuate the device.

### New Fiat Electric Generator and Motor Starter.

Advantage was taken of the Lyons Sample Fair, which opened on March 1st, to present to the public the first of the Fiat cars built in accordance with the post-war programme. This model, officially known as Model 501, is rated at 12-16 h.p., and is a light car supplied complete with electric lighting and starting, and all accessories. A new feature is the adoption of a silent chain for driving the camshaft and the electric generator. This chain passes round the camshaft and the electric-generator pinions, and can be adjusted in a very simple and ingenious manner by the latter. The electric generator, which is of circular section, and has its shaft mounted eccentrically, is received in an extension of the crankchamber, and passes through this into the timing-gear housing. By turning the generator in its housing, the chain can be adjusted, and in order to make this adjustment accurate and simple a worm and screw control is provided.

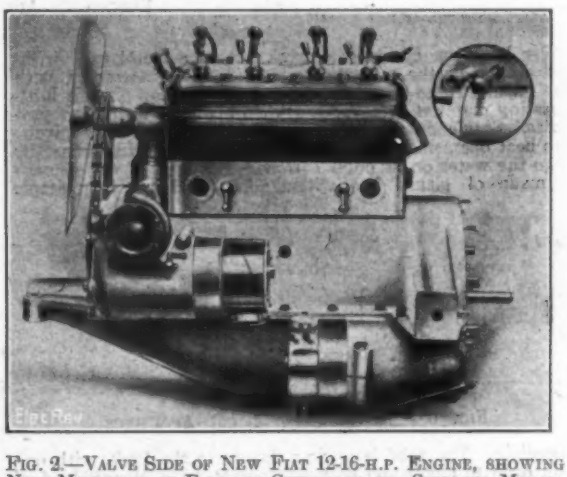


Fig. 2.—Valve Side of New Fiat 12-16-h.p. Engine, showing Neat Mounting of Electric Generator and Starting Motor.

as shown in fig. 2. White the camshaft is driven by chain, the Fiat engineers have retained the transverse shaft for the magneto and water pump. This gives complete accessibility, for the magneto distributor and breaker box are outwards.

The whole of the electrical set used on this car is built in the Fiat factory. The equipment comprises the positively driven electric generator, an electric motor placed on the left-hand side of the engine base chamber, and having a sliding pinion engaging with a ring gear on the flywheel, a battery carried in a box on the frame, and head, side, dash, and tail lamps. Starting the engine is effected simply by pressing a button on the dashboard. The details of the electrical system have received very careful attention, all the electric wires being carried in metal conduits.

### Elmbank Electrical Specialities.

We have received from Messrs. James Allan, Senr., & Son, Ltd., of Elmbank Foundry, Glasgow, a catalogue illustrating electrical heating apparatus designed on novel and efficient lines. The adaptable one-unit fire (Robinson's patent) should prove a most useful and convenient device. In fig. 3 the fire is arranged as a grill or toaster; in fig. 4 it is shown as a radiator for warming a room; while in such a position as seen in fig. 5 it will boil or fry. The fitting has an electro-plated copper finish, and is complete, including 6 ft. of flexible cable.

With regard to the hot-water warming apparatus seen in fig. 6, this consists of an electric boiler with one "Gloworm" element of 1-unit capacity connected to three 6-ft. lengths of 2-in. cast-iron hot-water pipes with a 3-way branch siphon which allows for filling and expansion. This boiler is suitable for connecting to either pipes or radiators. It is supplied with either flow or return tappings for screwed pipes or sockets for caulked joints.

The "Gloworm" immersion heater for use with the above boiler has been designed to work within a metal tube without danger of the resistance ribbon coming in contact with the tube. There is therefore no necessity for placing heat-resisting material over the heating ribbon for insulating purposes. Single or three varying degrees of heat are given; the heat operating on the metal tube which readily transmits it to the water on its outer surface. The body of the element is made of glazed heat-withstanding and non-hygroscopic porcelain. The tube is made a fixture in the tank, with one end open to admit the heating element. The flanged end of the latter closes up the aperture; the terminal connections are outside this flanged piece, and a threaded porcelain cap protects the terminals. The sectional construction of the element enables it to be made up in various lengths, the whole of the parts being securely held together by a bolt through the centre. The design and construction of "Gloworm" elements enable them to be used for a large variety of industrial purposes.

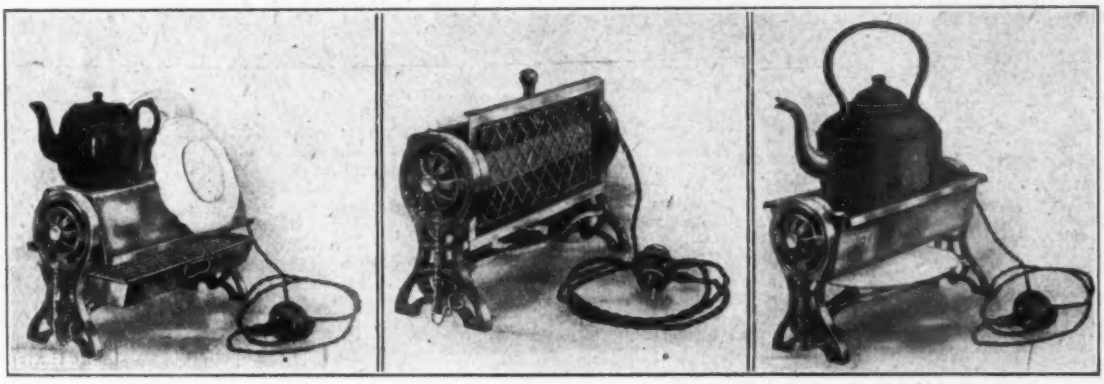


Fig. 3. Fig. 4. Fig. 5.

Robinson's Adaptable One-unit Fire.

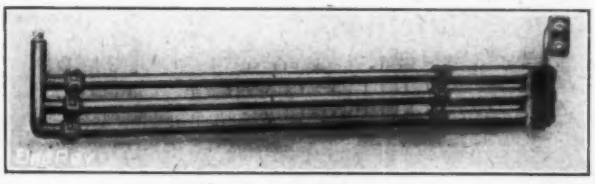


Fig. 6.—Hot-water Warming Apparatus.

**London's New County Hall.**—The London County Council has decided to proceed immediately with the work of finishing the new County Hall.

## THE ELECTRICAL DEVELOPMENT ASSOCIATION.

We give below particulars of the constitution and objects of the Electrical Development Association, which has been established to promote general propaganda and publicity for the benefit of the electrical industry as a whole. In December, 1917, the President of the Institution of Electrical Engineers, Mr. C. H. Wordingham, realising the necessity for such an organisation, called a meeting of the representatives of all sections of the industry, to consider the matter. A Committee was formed to carry out the preliminary work, consisting of the following members, representing the bodies named :—

| | |
|---|---|
| Institution of Electrical Engineers. | Messrs. C. H. Wordingham, W. A. Chamen, and W. A Gillott. |
| British Electrical and Allied Manufacturers' Association. | Messrs. C. O. Bastian, C. R. Belling, A. F. Berry, T. Clifford Palmer, D. N. Dunlop, and F. H. Williams. |
| The Incorporated Municipal Electrical Association. | Messrs. F. Allen, J. H. Bowden J. Christie, A. C. Cramb, S. E. Fedden, and E. E. Hoadley. |
| Conference of Chief Officials of London Electric Supply Companies. | Messrs. R. S. Downe and E. J Walker. |
| The Incorporated Association of Electric Power Companies. | Messrs. E. T. Ruthven-Murray and W. B. Woodhouse. |
| Electrical Contractors' Association. | Messrs. Duncan Watson and Rashleigh Phipps. |
| Cable Makers' Association. | Mr. Ll. B. Atkinson. |

From this body an Executive Committee was formed, comprising Mr. A. F. Berry (chairman), Mr. D. N. Dunlop (vice-chairman), Mr. A. C. Cramb, Mr. R. S. Downe, Mr. E. T. Ruthven-Murray, Mr. Duncan Watson, Mr. F. H. Williams, Mr. W. A. Gillott, and Mr. Ll. B. Atkinson.

The industry has been approached through the various institutions or associations by their representatives on the Committee, in order to obtain subscriptions to an initial fund; these endeavours have met with success, and sufficient support to the scheme has already been given to justify the Committee in incorporating the Association. It is intended to establish and incorporate the Association under the name of "The Electrical Development Association," and offices will be taken in a central position in London.

The primary objects of the Association are to encourage engineers, architects, builders, &c., and to educate the public generally, to make the fullest possible use of electricity; to collect, co-ordinate, and distribute data of interest to members of the Association.

The Association will work through its Executive Committee, which will be composed of representatives of the Institutions or Associations named above, and others who may be identified with any branch of the electrical industry.

Members of the Association will consist only of those interested in the manufacture of electrical plant or apparatus, supply authorities, and installation contractors.

The revenue of the Association will be derived from each contributing section of the industry in a manner most suitable to the constitution of such section—*e.g.*, by donations, subscriptions, sale of pamphlets or other propaganda matter, &c. A complete range of posters, pamphlets, and literature will be available for distribution either by the members themselves or by the Association.

It is evident, from the success already achieved, that a concentrated and determined effort only is needed to replace by electrical methods the older services for industrial and domestic purposes. This is the main object of the Electrical Development Association. By the cordial and enthusiastic co-operation of all sections of the electrical industry its position can be greatly strengthened, resulting in a considerable increase in the volume of business in all branches of electrical trade.

**As stated in our leading article last week, Mr. J. W. Beauchamp has been appointed Director of Development, and under his able guidance we anticipate that valuable results will be obtained, when the organisation of the Association has been completed and the machinery has been got into working order.**

## THE CORROSION OF CONDENSER TUBES.

Part III of the Report to the Corrosion Committee of the Institute of Metals, by Dr. Guy D. Bengough and Dr. O. F. Hudson, deals with the subject of corrosion under practical conditions as it appears to the authors. They express the view that corrosive attack on condenser tubes is more diverse in character and complicated in nature than has been generally supposed. The first action is one of chemical oxidation, and secondary actions are of great importance. No one single remedy is likely to be found effective for all the different kinds of attack which occur in practice. The nature of the tube used and the protective measures chosen should be dependent on the particular set of conditions.

The following is a set of conditions under which a 70 : 30 brass condenser tube should have a minimum life of twenty years :—

(*a*) Only clear water to enter the tubes, or water which will not deposit suspended matter.

(*b*) The water must be free from gases in suspension, and must not contain more than the normal amount of air in solution.

(*c*) The water must be neutral or not more than very slightly alkaline. It must be free from ammonia and certain other specially harmful substances, which are, however, of comparatively rare occurrence in technical waters.

(*d*) The temperature of the cooling water in the hottest part of the condenser should not exceed 35 deg. C.

(*e*) The velocity of the water should be about 5 or 6 ft. per second.

(*f*) The steam should be properly distributed in the condenser, according to the best modern practice.

A water supply which varies considerably in composition at different times of the year involves special problems and must be excluded from the above statement at present.

In practice tubes fail sooner than the period stated, because the normal slow roughening of the tube by chemical oxidation is locally speeded up by factors which are for the most part independent of the tube. A preliminary attempt is made to gather the more important of these factors into a tabular statement, which is given below. In practice factors set out separately in the table may act jointly. Causes of corrosion are not arranged in the table in order of importance, since this order varies in different types of installation. The effect of water velocity on the rate of corrosion varies with the nature of corrosion.

The effect of the presence of a scale on the rate of corrosion is considered to be of great importance. Of the substances that commonly occur in scale, calcium carbonate is one of the most important. Its effect varies with its physical condition. It may exert almost any kind of effect, from a considerable degree of protection to a serious attack.

Some observations are described on the effect of a form of electrolytic protection (the Cumberland process) at the Southwick power station of the Brighton Corporation, which is under the charge of Mr. J. Christie, who has placed many facilities at the authors' disposal. The conclusion is reached that the process ensures a prolonged life for the tubes under Southwick conditions, provided that it is applied to new tubes, *i.e.*, to tubes that have not begun to corrode before the process is put in operation. The process should be applied continuously and not intermittently. The authors consider that the thin uniform scale which is maintained on the tubes by the process is an important factor in preventing serious corrosion. One of the important functions of the scale is to prevent contact between the tubes and harmful deposits and products of corrosion; in addition, it slows down, but does not entirely prevent, the general oxidation of the tubes. The authors consider that further evidence is necessary before the value of the process can be estimated as regards prevention of corrosion in certain types of water other than seawater. Other possible methods of protection are briefly considered, and a preliminary account is given of a pre-oxidising process for reducing the rate of corrosion.

**Hydro-electric Work in Italy.**—The need for finding employment for discharged soldiers and others has induced the Italian Government to set aside a milliard lire for the execution of public works, the principal of which are hydro-electric installations. The increase of the subsidies to railways and tramways has also been decided upon, while financial assistance will be granted to construction firms to complete contracts under way. As an illustration of the progress made in the development of the country's water-power resources, it is observed that concessions have in recent months been made to the extent of 500,000 h.p. for industrial purposes, and more are to follow. The employment of water power will be stimulated in every possible way, and capitalists are asked to help the Government in this work.

Causes of Condenser Tube and Ferrule Corrosion. (Water side only considered.)

| *Cause.* | *How Produced.* | *Nature of Action.* | *How to be Remedied.* |
|---|---|---|---|
| A. Foreign bodies carried in and accumulation of products. | A1. By ferric hydrate flakes from water ends.<br>A2. By ashes, clinkers, &c.<br>A3. By sludge of sorts in water supply. | Complete corrosion. | A1. Paint the pipe line and water ends. Increase water velocity.<br>A1, A2, and A3. If worth while, trap the water supply or pass it through a screen. In some cases increase water velocity. |
| B. Acid or other bad or variable water supply. | B1. Some river supplies, *e.g.*, Tyne.<br>B2. Some canal supplies, *e.g.*, ship canal.<br>B3. Some well supplies.<br>B4. Some estuarine supplies.<br>B5. Some cooling tower arrangements. | Complete corrosion and rapid general thinning. | Keep water supply slightly alkaline. Use special tubes adapted to the special conditions. |
| C. Temperature in condenser too high. | C1. Hot inlet water, *e.g.*, tropical.<br>C2. Low water velocity.<br>C3. Partial blocking of tubes. | C1. Dezincification.<br>C2. Dezincification.<br>C3 See A3. | C1 and C2. Use special tubes.<br>C2. Increase water velocity.<br>C3. See A3. |
| D. Undue aeration. | D1. Errors in pump and pipe-line arrangements.<br>D2. Eddies near inlet causing water-line effect. | D1. Complete corrosion.<br>D2. Complete corrosion. | D1. Remedy air leaks, &c.<br>D2. Special ferrules. Possibly increasing velocity of water with modified design of water end. |
| E. Unsuitable composition of tubes. | E1. Zinc or impurities in too great amount.<br>E2. Surface of tube not sufficiently copper rich. | E1. Varies.<br>E2. Dezincification. | E1. In manufacturing.<br>E2. Probably by attention to details of annealing and pickling during manufacture. |
| F. Defective packing of tubes. | F1. Leaks caused by perishing of the packing material, especially in acid water.<br>F2. Collapsing of tubes. | F1. Varies.<br>F2. Varies. | F1. Use good tape packing. Red lead is sometimes useful to prevent leakage.<br>F2. Do not crush tubes when inserting them. |
| G. Physically bad surfaces of tubes, *e.g.*, bad spills and laminations. | Foreign bodies caught and trapped which would otherwise be swept away. | Complete corrosion | During manufacture. |
| H. Thermo-electric action in condenser. | By steam impinging directly on tubes, or being improperly distributed. | Dezincification. | Only occurs in condensers of old design when steam is not properly distributed. |
| I. Too low water velocity. | Gases given off inside tube and not immediately swept away. | Complete corrosion near inlet end. | Increase velocity of water. Do not use main condenser for auxiliary machinery in port. |

## CORRESPONDENCE.

*Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### Rotor Currents of Slip-ring Motors.

As an inspector of electrical plant, I feel indebted to "Rotor" for raising this question, and fully endorse his, and also Mr. Jones's, remarks. I have personally experienced much difficulty when testing, or investigating, motor defects, and have often expressed surprise that British manufacturers should make no sort of reference whatever to rotor volts or amperes. Some even give very incomplete particulars as to stator current, H.P., and speed, while usually no reference is made to efficiency, power factor, or hourly rating. Mr. Jones remarks that he has known *no* manufacturer give any such data, except by request; I have seen many German motors, of A.E.G. manufacture, giving very full and accurate data, as to rotor amperes, volts, power factor, efficiency, rating, &c., and consider it quite time we followed yet another German example.

**N. W. Walker, A.M.I.E.E.**

Sheffield, *April 12th*, 1919.

### Telephone and Telegraph Line Construction.

With reference to the above appearing in this week's issue of the ELECTRICAL REVIEW, I wish to say that the overhead telegraph and telephone wires from London to St. Margaret's Bay, and thence by cable, &c., to Paris, caused me much amusement and astonishment some years ago.

I have *not* been down to Dover or St. Margaret's Bay for many years, so do not know whether this matter has been rectified or not; however, when I was last there all the wires were overhead, and the Post Office was going to the enormous expense of putting all telegraph wires, &c., to Birmingham and Glasgow underground. I believe Glasgow and Edinburgh have since been connected up in this way.

The numerous wires going to the Continent, with the strong winds of the South Downs, and the possibility of tampering with them, especially in such times as we have just passed through, seemed to me, and do seem, absolutely ludicrous. We shall probably be *fully* awake some day.

**D. R. Broadbent.**

London, S.W. 1, *April 19th*, 1919.

### The E.P.E.A. Award.

Will any of your readers who are engaged in power-station work be good enough to state whether they actually *know* of anyone who has received the 20 per cent. plus £90 award? In the district from which I write, we have received nothing save specious promises; our local committee cannot give us any satisfaction, and monotonously stated month after month that "Well, we *must* get it next month," and that the award will *have* to be paid, including 12 months' arrears. Now, Mr. Editor, "next month" is conveniently like unto "to-morrow," in that it never comes; whilst, when dealing with an association absolutely without pluck or power, there is *no* "*will have to be paid*" about the matter at all. Our chiefs and committees realise this, act upon it, and give us—nothing. The present attitude of the E.P.E.A. reminds one very painfully of the dignified non-committal attitude of the jellyfish.

**Connaught T. Smith.**

### The Definition of Electrical Resistance.

In your reviewer's remarks concerning "Electricity and Magnetism for Engineers," by Harold Pender (your issue of April 11th), he expresses regret at the growing custom of explaining resistance by reference to the heat equation $JH = i^2Rt$.

He suggests that this method of approaching the matter is clumsier than that derived from Ohm's law, but since resistance is a physical property of a conductor by virtue of which energy is dissipated when the conductor carries a current of electricity, I hardly feel in agreement with him. It seems better for students to look on resistance as a physical property of a conductor rather than as the ratio of two other electrical quantities.

One surely should not expect this view of resistance to lead to such errors of definition as that pointed out in the review of the book, remembering that Joule's law is susceptible of simple experimental demonstration using given conductors.

As this question of the best method of presenting this matter to the student may be of interest to both students and teachers, your reviewer may feel willing to say more about it.

**Charles H. Wright.**

Glasgow, *April 16th*, 1919.

## LEGAL.

### UNWIN *v.* ARNOLD & SONS.

IN the City of London Court, on April 15th, before Sir John Paget, Bart., K.C., Deputy Judge, Mr. Frank J. Unwin, electrician, trading as F. J. Unwin & Co., 6, Lythos Road, Hampstead, claimed £6 5s. against Messrs. Arnold & Sons, surgical instrument makers, Giltspur Street, E.C., for supplying five medical electrical batteries. Plaintiff said that the defendants made certain complaints, and he admitted that certain details wanted rectification. He exchanged them and sent five new batteries which were in perfect order. Nothing was said until over a month after, when he applied for the account. Defendants then said they were going to return the batteries because they were faulty. In that time the batteries would have been partly weakened if not run down, and he refused to have them back because he knew they were in perfect order before they were sent out. He had tested them before they went out, and they showed the regular standard of 1.5 volts. He was willing to supply the defendants with a better battery, and submitted samples. They refused to look at them until he took back the five batteries. The batteries now in dispute were well known in London. He supplied them to firms who supplied hospitals. It was the cheapest kind of battery that he made. Although the work was not all that could be obtained in pre-war time, they were good batteries, and good value.

The DEPUTY JUDGE: Does it affect the efficacy of the current?

Plaintiff said it did, and that defendants knew it. Defendants had been satisfied with the batteries which he had supplied for £2 each. Those in dispute cost £1 5s. Defendants asked for a cheaper battery, and they got it. But apparently they did not like it. In cross-examination, plaintiff said defendants' buyer did not say that the batteries now sued for were unworkable. He would hardly have sent them to hospitals. He did not know the purpose for which they were required. He exchanged them without admitting that they were unmerchantable. No doubt there was some roughness about the cases, but he had not the workmen to-day that he had formerly.

Mr. S. C. PEELING, defendant's buyer, said he had been dealing in electrical coil batteries with the plaintiff for some time. When he gave the order he carefully gave no price, knowing the present-day difficulties. When plaintiff sent the first five batteries they were badly finished and unsaleable. With each coil there was a slide to increase or decrease the current. In no instance would the slide of plaintiff's coil move. He offered a better price for a better article, but the second lot were worse than the first.

Mr. A. HAMPTON, general manager to the defendants for 35 years, said that four out of five of the batteries sued for were unworkable. The platinum points were not in their position, which was vital with a coil battery.

The DEPUTY JUDGE thought that 25s. was very low in price for a battery. They were, in fact, extraordinarily cheap.

WITNESS said that that was the wholesale price.

The DEPUTY JUDGE: Ah! We poor people have to pay a great deal more.

WITNESS: Thirty-five shillings. They used to be made in Germany. Defendants produced the coil batteries, and plaintiff made some of them work, in which condition they were put on the bench for the Court's inspection.

Mr. E. H. WILLIS, electrical engineer, said he had examined the coils, and he considered they were not at all merchantable. The construction was quite faulty. They could only be altered by an expert. None of the platinum points were in apposition. He admitted that the difference between the cost of manufacture and the selling price to the public was extreme, because the goods passed through two or three hands before they were bought by the public, and all "wanted a bit."

The DEPUTY JUDGE said he knew something about electrical batteries. One could not get for 25s. what one might expect for £3. Judgment for the plaintiff, with costs. Defendants did not complain in time.

### BRITISH THOMSON-HOUSTON CO.'S TUNGSTEN PATENT.

MR. JUSTICE SARGANT, in the Chancery Division, on April 16th, gave judgment in an application by the British Thomson-Houston Co., Ltd., to allow them to amend the specification of an invention relating to their process for the treatment of metallic tungsten, and for the manufacture of electric filament lamps therefrom.

There were several opponents, the chief being Messrs. Duram, Ltd., against whom the applicants unsuccessfully brought an action for infringement in 1916. This decision was finally ratified by the House of Lords. Messrs. Duram, Ltd., had also presented a petition for the revocation of the patent.

Mr. COLEFAX, K.C., arguing in support of the application, said that the proposed amendment would have the effect of more clearly defining the scope of the invention.

Mr. TERRELL, K.C., appeared for the opponents, Messrs. Duram, Ltd. He submitted that the amendment should not

be allowed, on the ground that it was in effect an attempt to introduce totally new subject matter.

Mr. Colefax, in the course of his argument, read a number of affidavits relating to working arrangements which had been made with other companies, and the manner in which those arrangements had been carried out, and he quoted extracts from a number of advertisements which had appeared in the Electrical Review warning people against infringement of the patent.

Mr. Terrell, K.C., complained that some of the advertisements referred to were based upon a judgment obtained in default of defence by the British Thomson-Houston Co., against Messrs. Duram, Ltd. Upwards of 30 actions were brought during the years 1913 to 1915, and he alleged that the advertisements had been issued by the British Thomson-Houston Co. in maintenance of their policy of threatening the trade. He argued that there was no subject matter in applying heat to coherent metal which would justify an amendment. The claim was really merely for heating metal. The House of Lords had held that there was no subject matter for the patent.

Mr. Colefax repudiated a suggestion that he had deliberately caused delay so that he might in the meantime threaten defendants by advertisements in the Electrical Review and other trade papers. Not a soul, he said, had come forward connected with the trade to say that he had been terrorised.

His Lordship dismissed the application with costs. The contention of the opponents was, he said, well founded. He did not think that the amendment was authorised by the Act as the proposed alteration would substantially alter the invention. In any case, he did not think that the amendment, if allowed, would save the patent if it were challenged.

---

Lake Hotel Co., Ltd., *v.* Kerry Electric Supply Co., Ltd.

At Killarney Quarter Sessions, Judge Dromgoode heard this action for recovery of £1 14s. 4d., money alleged to have been illegally and improperly claimed by defendants and paid to them by plaintiffs under protest. It was explained that plaintiffs regarded the case as raising an important question of principle. Mr. John Hilliard, managing director of the Lake Hotel, stated that his company had been getting electric light since 1897, and that at first the charge was 5d. a unit, which was afterwards increased to 6d. The defendants made a demand last September quarter for 7d., and he sent them a cheque for 6d. per unit. He had had no intimation that prices were being raised; but in November a circular was sent out stating that the price was being raised from 6d. to 7d. The hotel was outside the urban area.

During the arguments, contention was made that the money was paid on foot of an illegal contract—as it was illegal to supply energy without Parliamentary sanction or Board of Trade licence—and was, therefore, irrecoverable; and, again, that, if the contract were legal; the undertakers were at liberty to make any agreement with the consumers.

Mr. J. McDonnell, manager of the Electric Light Co., said a circular was sent out in April, 1918, increasing the price from 6d. to 7d.; two or three people outside the urban area paid 7d., as well as some people in the town.

His Honour held that the supply to the hotel was illegal, and that nothing could be recovered on foot of any contract. That left Mr. Hilliard in the same position as if he were defendant and not plaintiff—that was, the money might be recovered from him. Accordingly, he would give a decree for the amount claimed.

---

Workmen's Compensation Case.

At Bolton County Court, last week, his Honour Judge Spencer Hogg gave judgment in a case in which compensation was sought from the Bolton Corporation for the death of Mr. Clough, an assistant turbine engine driver, which occurred at the Back-o'-th'-Bank Electricity Works. It was suggested at the hearing, on behalf of the Corporation, that the death might be due to suicide, and it was contended that Clough's work did not require him to go near the tail race, where he was drowned. His Honour said that on the evidence he entirely rejected the suggestion of suicide. The deceased's duties included seeing that everything was in order, and to do that it was part of his duty to be about the pump house, near which he was drowned. He found that the accident arose out of the employment, and awarded the plaintiff £300 compensation.

---

**A New Photometer.**—A new type of photometer was devised by the Illuminating Engineering Society, at the invitation of the Government, to give a rapid reading of the light given off at any moment by a brilliant source like a star shell or flare. It consists of a small tube with a tiny electric lamp inside it at one end. An opening is cut in the tube lengthways to admit a strip of metal stencilled with the letters of the alphabet. When the lamp is on, each letter of the alphabet is illuminated in a descending scale according to its distance down the tube. If the light which falls on the instrument from the outside happens to be the same as the internal illumination of any particular letter, that letter will vanish.

# BUSINESS NOTES.

**Export Prohibitions.**—A further list of alterations in export prohibitions appears in the *London Gazette* for April 15th.

**Non-Ferrous Metal Industry Act.**—Additions to the list of licences granted under this Act, appear in the *London Gazette* for April 15th.

**Copper Sulphate Order, 1918.**—The Minister of Munitions has suspended the operation of the above order as from April 15th, 1919.

**The B.E.A.M.A.: New Members.** — We are informed that the following firms have been elected members of the British Electrical and Allied Manufacturers' Association:—Accumulators (Birmingham), Ltd., Birmingham; Brolt, Ltd., Birmingham; Davies, Kent & Stewart, Ltd., London; Ebonestos Manufacturing Co., Ltd., London; Hightensite, Ltd., London; Holden & Brooke, Ltd., London; Jenson & Nicholson, Ltd., London; Chas. Joyner and Co., Ltd., Birmingham; Arthur Lyon & Wrench, Ltd., London; F. & A. Parkinson, Ltd., Leeds; T. E. Slaughter & Co., London; L. Vandervelde, London; Wardle Engineering Co., Ltd., London; H. Wiggin Co., Ltd., London.

**C.A.V. and Standardised Orders.**—We are informed that C.A.V. lighting and starting sets are now standardised on the following all-British cars:—Austin, Arrol-Johnston, Daimler, Humber, Sunbeam, Vauxhall, Wolseley, besides several others. This fact bears testimony to the excellence of Messrs. C. A. Vandervell's products, and the public demand for the equipment of cars with these adjuncts.

**The C.M.A.: New Member.**—It is announced that, as from April 2nd, 1919, the Liverpool Electric Cable Co., Ltd., Bootle, Liverpool, became members of the Cable Makers' Association.

**Plant for Disposal.**—Aldershot U.D.C. invites offers for 17 open-type twin-carbon Oliver arc lamps complete, 24 Watson prepayment meters, 18 Angold magazine flame arc lamps, 32 5-amp., 50 10-amp., and 29 25-amp. Reason maximum demand indicators.

Rhondda U.D.C. electricity works has for disposal a complete suction gas plant, consisting of one 22-B.H.P. Fielding & Platt gas engine, gas-producing plant, dynamo, and switchboard. For further particulars, see our advertisement pages to-day.

**The Copper Market.**—Addressing shareholders of the Rio Tinto Co., Ltd., recently, Sir Charles W. Fielding, K.B.E., said that fuel still continued at too high a price to enable them to resume steam shovel work, and a great many of their locomotives remained idle, but sufficient were at work to produce their immediate demands of ore. Regarding the future, the Allied Governments took copper under direct control, and, as a very reasonable precaution, saw that the supplies at hand and coming forward for delivery would be ample. The termination of hostilities had left large stocks to be disposed of, and the stagnation of manufacturing that had come between war and peace had increased those stocks. Even with considerable world reduction of output, copper would exist in excess of demand for months to come, but the cost of production generally having increased—and he expected to some extent that increase would be permanent—the old very low prices were not likely to return for a long time. Especially would this be the case, as the American producers realised that they could sell practically as much of their output—and of the United States Government stocks which they controlled—at a price leaving them a reasonable profit, as they could dispose of at a loss. The cost of producing copper in America after the transition period was therefore likely again to be the chief factor in regard to the company's profits. He was not anxious on this head in regard to the future, although the present year would naturally suffer from the large stocks of copper and the slowness in re-establishing trade.

**Lead.**—In their weekly report Messrs. James Forster and Co. state:—"Government controlled lead is £25 ex warehouse; American lead, April shipment, is offering at £24 10s.; forward (July-August) has been done (50 tons) at £24, and there are sellers over. A few weeks ago a deputation of American metal dealers interviewed the Minister of Commerce to urge the removal of all restrictions on exports to and imports of metals into Europe. The Minister addressed a few salutary words to the deputees which may be repeated here. His advice was to give the people on the other side a chance of disposing of their war stocks, and he asked them to remember that England, France, and Italy were hung up with huge stocks largely imported from America. We need similar plain speaking here. In the case of lead the Government have approximately 100,000 tons, or ten times more than any stock held in pre-war times. Until that stock is reduced to within reasonable limits, no encouragement should be given on the Metal Exchange to any selling of American lead. The drop in price of the last three weeks has cost the Government £300,000, and no extra quantity of lead has been sold in consequence. No free dealing in forward lead is possible so long as the huge stock remains, as the trade will continue to buy from hand to mouth; the conditions practically prohibit speculation, but offer an easy inducement to manipulate the market such as we have recently experienced."

**Catalogues Wanted.**—The Electrical Equipment and Installation Co., 10, Eastcheap, E.C. 3, wish to receive catalogues of every description of electrical apparatus.

The Victor Engineering Co., Ltd., have commenced business at 18, Holland Street, Glasgow, to carry on general engineering (small work) and millwrighting work, electrical power work (A.C. and D.C. for collieries and factories). Manufacturers or agents are invited to forward catalogues of their specialities.

Messrs. W. Arthur Kerr & Co., consulting engineers, factory and works designers, have moved to larger offices at 7, West George Street, Glasgow. Manufacturers issuing revised catalogues of goods in which they are interested are invited to send them copies.

**Trade Announcements.**—Mr. W. H. Miller, late engineer and manager of the Fleetwood Electricity Works, and Mr. A. B. Farrell, late resident station superintendent of the Belfast Electricity Works, have entered into partnership in business as consulting and contracting electrical and mechanical engineers as Miller & Farrell at Albert Street, Fleetwood. Manufacturers and vendors of electrical plant and apparatus are asked for catalogues, &c.

Messrs. Williams (Birmingham), Ltd., have held special meetings, at which they have altered and extended the company's objects, and they will carry on business as electricians, electrical contractors, constructors, &c., of electrical installations, manufacturers of electrical plants, &c., as set forth in the terms of resolutions which appear at length in the *London Gazette* for April 15th.

**Catalogues and Lists.**—It may be understood, as a general rule, that copies of publications mentioned in this section may be obtained on application to the firm or company at the address given.

Messrs. James Allan, Senr., & Son, Ltd., Elmbank Foundry, Glasgow.—Four-page illustrated list, giving particulars and prices of their "Elmbank" electric specialities, including the adaptable one unit fire (Robinson's patent), the "Gloworm" interchangeable immersion heater, and domestic electric hot-water warming apparatus.

The B.E. Co. (of London and Birmingham), Ltd., 57, Upper Thames Street, London, E.C. 4.—Advance price-list (five sheets) of their Birmingham-made electrical supplies, including adaptors, ceiling roses, cut-outs, fuseboards, tumbler switches, bayonet lampholders, wall plugs and sockets, hand lamps, and flexible cords.

Messrs. Newton & Wright, Ltd., 72, Wigmore Street, London, W.—Price leaflet giving corrected prices of "Snook" apparatus appearing in Section 3 of their catalogue.

The Parsons Motor Co., Ltd., Town Quay Works, Southampton.—36-page publication, entitled "Industrial Installations," being a collection of illustrations and designs showing Parsons engines used in numerous types of stationary and portable plants, including self-contained electrical sets, electric welding, pumping, air compressor, agricultural, electric power station, and other plants.

**The Belgian Charleroi Electrical Works.**—According to a Brussels newspaper, the Société des Ateliers de Constructions Electriques de Charleroi had the good fortune of finding its works almost intact after the retreat of the enemy. The oldest works—the Marcinelle Works—produces switchboards, tramway motors, &c., whilst the most recent and more important works at la Villette turns out all kinds and sizes of electrical machinery. It comprises mechanical shops, bronze foundry, cable factory and copper drawing plant, enemy damage having been caused only in the cable factory. Thanks to the practical immunity from damage owing to the Germans having utilised the works for their own purposes, it was possible for the company to resume working very soon, and 700 men are now employed, with the prospect of the number being increased to 1,000 shortly. The company had a turnover of the value of £1,000,000 in 1913, which would have risen to £1,200,000 in 1914 if the war had not occurred.

**The Retreat Through Belgium.**—The *Times* special correspondent at Brussels, in the course of an article on the wastage of material during the German retreat from Belgium, mentions that at the Ateliers des Constructions Electriques, at Charleroi, one of the largest in the country, is lying more than a million pounds' worth of electrical plant. "It seems that all dynamos and motors, whether brought from Germany or looted from Belgium, were sent here for repair. Here, also, are many British tools captured from us and recaptured from the enemy."

**The Athens Exhibition.**—The Austin Motor Co., Ltd., of Northfield, Birmingham, have secured an order for an Austin electric lighting set for the lighting of the All-British Exhibition to be held in Athens in September next.

**Peace Celebrations.**—While no official announcement has been made with regard to the lighting concessions that will be granted for the celebration of the signing of terms of peace, we have been informed on excellent authority that the lighting restrictions will be relaxed for a period of four days.

**French Working Hours.**—A protocol has been signed by the French Union of Employers of the Metallurgical, Mining, Hardware, Electrical, and Metallic Industries and the Federation of Workers in Metals for an eight-hour working day without reduction of wages, to come into force on June 1st.—*Times*.

**Deed of Assignment.**—W. Cox and W. R. Childs (Cox and Childs), plumbers and electricians, 64, Stockwell Gate, Mansfield.—Last day for claims for a first and final dividend April 21st. Trustee, Mr. P. J. Bradfield, Bishops Chambers, Mansfield.

**"Welcome Home" at Hornsey.**—On the evening of April 16th, at the Hornsey Electricity Works, the Borough Council Electricity Department held a smoking concert to give a hearty welcome to those members of the staff who had returned from the war. Councillor Moritz, chairman of the Electricity Committee, presided, and he was supported by Councillor Wood, the vice-chairman. In his address of welcome the chairman gave a brief record of the services of each man, and spoke of the satisfaction which the Committee felt in not having one of the warriors killed or permanently injured, although some of them had borne the stiffest of the fight. The hall was tastefully decorated, and a stage had been erected for the purpose of the entertainment, which included songs, recitations, and a dramatic turn, given by members of the works' staff and friends. Before the war the department held many staff smoking concerts, and it is hoped to resume these.

**The Holidays.**—Everybody who can afford it—and some who cannot—will be wanting a good holiday this year. Doubtless, however, many are waiting on the Peace celebration arrangements before they decide when to go. The demand on the railways will be extremely heavy, and it is desirable that, for the convenience, comfort and safety of all, the peaks should be flattened out. It is hoped that business houses will be able to arrange their holiday programmes so that there shall be more use of the railways in May and June, so as to avoid a repetition of the pre-war rush of the succeeding months. There is still a shortage of rolling stock. Those who can go away on Tuesdays, Wednesdays, Thursdays or Fridays, should do so.

**Bankruptcy Proceedings.**—W. H. Wilson, consulting engineer and a director of limited companies, Tower Buildings, Water Street, Liverpool, formerly a partner in T. L. Miller, Wilson and Pegg.—Last day for receipt of proofs for dividend May 3rd. Trustee, Mr. L. Nicholas, 19, Castle Street, Liverpool.

William T. Smith, electrical and mechanical engineer, Victoria Street, and 60, Hampden Street, Bolton, Lancs.—At the adjourned public examination held last week at Bolton, the Official Receiver said there had been successive adjournments of the case, but they were no further forward than they were 15 months ago. They had given the debtor every facility to realise the values of his inventions. The debtor was the patentee of what he believed were valuable improvements in ring spinning machines, and he was confident he would eventually raise a substantial sum of money. The debtor signed a proposal submitted by the Official Receiver to pay 7s. 6d. in the £, as to 2s. 6d. down and two instalments of 2s. 6d. each when he was able to pay them. The examination was concluded.

**A Siemens Social.**—Last week a successful dinner and smoking concert was held by the employés of the machine shop and tool room of Messrs. Siemens at the Vine Hotel, Stafford, and there was a very large attendance. Mr. M. Kenworthy, shop engineer, who presided, threw out a suggestion that not only should they have dinners and parties in the winter, but an annual trip to a popular resort in the summer. If other people could travel on "Bass," they certainly ought to do so on "Electricity." Mr. W. H. Parker, general manager, appealed for mutual confidence, goodwill, and trust in one another.

**Social.**—The Victory Social given by the "Z" Electric Lamp Manufacturing Co., Ltd., at St. Mary's Hall, Putney, on Monday evening, April 14th, to their Southfields employés, was an unqualified success. The entertainment consisted of a concert and dance. The artistes were drawn entirely from the employés. The guests numbered about 400.

**To Develop Italian Foreign Trade.**—Under the auspices of the Minister Ciuffelli and the principal Italian credit institutions, there has been formed at Rome a large financial institution with the object of financing and developing Italian foreign commerce. The style of the new institution is Istituto Italiano di Credito per il Comercio Estero. The mode of operations will be the granting of credit to the Italian imports and exports, and the opening of branches of the bank in foreign countries to serve the financial needs of Italian trade abroad.

**The Tramway Industry.**—The foreign edition of the *Brill Magazine*, issued by the J. G. Brill Co., of Philadelphia, opens with the following "Look Forward":—"It needs no prophetic mind to see that out of the confusion and waste of war will arise the most substantially constructive era the world has ever known. Reconstruction of that which has been destroyed will be followed and paralleled with the development and upbuilding of old and new fields at a rate of progress that will make unprecedented demands upon all industries. The street railway industry will be among the first to be vigorously re-established and expanded, as the time and strength of workers must be conserved, and all of the normal activities of urban life, released from the constraint of years of war, must be provided with means of transportation. Public welfare in general, as well as business life in particular, are too dependent upon quick and convenient communication to permit of inadequacy in any department of this service, and it is more than probable that tramway managers will have an extremely difficult task to keep abreast of requirements."

**Agencies Wanted.**—A Chilean subject, possessing many years' experience of Chilean trade, having been in the employ of various United States firms and a British bank, is now starting in business for himself in Valparaiso or Santiago, and is paying a visit to the United Kingdom with a view to getting into touch with manufacturers and exporters of electrical fittings and accessories who desire to be represented in the Chilean market. (Reference No. 700.) Particulars from the Department of Commercial Intelligence, 73, Basinghall Street, E.C.

**Dissolutions and Liquidations.**—Blackwall Engineering and Welding Works, Ltd., West Ferry Road, Millwall, E.—Under the compulsory liquidation of this company, which was formed in June, 1917, to carry on the business of mechanical and electrical engineers, accounts have been submitted showing total liabilities £3,455, of which £1,135 is unsecured; assets, £1,281; and a deficiency of £3,595 as regards contributories. Mr. W. J. Warley, Official Receiver, reports that in August, 1917, Mr. George Steel (director) sold to the company for £900, in fully paid preference shares, certain plant, implements, tools, and other effects, and subsequently the company acquired for £600 in cash (part of which was returned in payment for shares), certain machine tools, the interest in the tenancy of the works, and a motor-car. The company's operations appear to have been principally confined to manufacturing and supplying mine chambers to the Government under contract. The loss in carrying on the business is estimated at £2,728. Debentures for £2,000 had been issued, and in June, 1918, Messrs. R. W. Walker and W. T. Botwood were appointed Receivers of the company's property. The Official Receiver adds that there is no prospect of a surplus of assets becoming available for the unsecured creditors.

Merton Metallurgical Co., Ltd., and H. R. Merton & Co., Ltd.—Claims must be sent in by October 31st, to the Liquidator, Sir Woodburn Kirby, 2, Metal Exchange Buildings, London, E.C.

Accuratact Magnetos, Ltd.—Meeting, May 19th, at 115, Finsbury Pavement House, London, E.C., to hear an account of the winding-up from the liquidator, Mr. J. J. Sneddon.

Rashleigh Phipps & Co., electrical engineers, 147, Oxford Street, W.—Messrs. A. Rashleigh Phipps and J. R. Bedford have dissolved partnership. Mr. A. Rashleigh Phipps will attend to debts and continue the business under the same style.

Robinson & Laird, steel letter cutters, die-sinkers, and electrical engineers, Hill Cross, Coventry.—Mr. H. Robinson and Mr. G. A. Laird have dissolved partnership.

Beck Engineering Co., Ltd., Eden Works, Hayes End, Middlesex.—Winding-up order made April 15th.

Balcke & Co., London, E.C.—First and final dividend, 20s. in the £, payable at 33, Carey Street, W.C. 2.

Universal Cheap Cables, Ltd.—A meeting is called for May 20th, at 30, Bush Lane, London, E.C., to hear an account of the winding-up from the liquidator, Mr. H. E. Oldham.

**Fire.**—The *Times* states that at the Walker shipyard, Newcastle-on-Tyne, of Sir G. W. Armstrong, Whitworth & Co., on April 15th, an electrical fitting shop and rigging store were damaged by fire.

**Book Notices.**—*Elementary Manual of Magnetism and Electricity.* By Andrew Jamieson. Revised by Ewart S. Andrews, B.Sc.Eng. Tenth edition. London: Charles Griffin & Co., Ltd. Pp. xiv + 372; many figures. Price 5s. net.—The late Prof. Jamieson's various manuals have had so wide a vogue and passed through so many editions that they need no introduction to the public; the author's lucid methods of exposition and the speaking illustrations with which the text is illuminated combine to render the subject interesting and to facilitate the absorption of information by the student. In the present edition no material change has been made in the contents of the book.

"Useful Information for Electrical Engineers." Pp. 32; 1 fig. Price 1s. net. 1919. Newcastle-upon-Tyne: J. H. Holmes & Co.—The title of this booklet is sufficient indication of its nature. The first portion is devoted to the care of electrical machinery, followed by particulars of standard cables and cable sizes for various distributions. Driving by belts and ropes is considered, and many useful tables and formulæ are included.

"Science Abstracts." Sections A and B. Vol. XXII. Part 3. March 31st, 1919. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each.

"The Design of Alternating-Current Machinery." By C. C. Hawkins, S. P. Smith, and S. Neville. Pp. xv + 392; 97 figs. London: Sir Isaac Pitman & Sons, Ltd. Price 18s. net.

"Post Office Electrical Engineers' Journal." Vol. XII, Part 1. April, 1919. London: "Electrical Review," Ltd. Price 1s. net.

"The Engineer's Year-Book for 1919." Compiled and edited by H. R. Kempe. Pp. xciii + 2,513; illus. London: Crosby Lockwood and Son. Price 25s. net.

The Spring number of the *M. & C. Apprentices' Magazine* contains special articles on the "Education of Skilled Craftsmen," by Mr. A. P. M. Fleming, Mr. A. E. Berriman, Prof. Mellanby, and Mr. A. W. Davies, as well as the usual variety of interesting items which gives this publication its unique position amongst such works magazines.

"Heat Treatment Bulletin," No. 9, of Automatic and Electric Furnaces, Ltd., consists of an interesting article by Mr. F. C. A. H. Lantsberry on "The Location of Hardening-Shop Faults," in which the theory of hardening is briefly explained.

In the current issue of *Salvage*, it is announced that the disposal of all salvage and surplus commodities is now centralised under the Ministry of Munitions and Supply, and the journal will henceforth have a much wider scope, probably under a new title.

## LIGHTING AND POWER NOTES.

**Aberystwyth.**—Street Lighting.—The T.C. has decided, subject to satisfactory terms, to have the streets lighted with electricity, on the basis of a scheme submitted by Mr. E. P. Perkins.

**Arbroath.**—Street Lighting.—The Arbroath E.L. and P. Co. has indicated to the T.C. that it is prepared to light the streets formerly lighted with 1,000-c.p. lamps at £21 per lamp per annum. The gas manager is to report on the cost of lighting the streets as effectively with gas.

**Australia.**—E.L. Schemes.—The Harden and Murrumburrah Municipality has decided to borrow £7,000 for an E.L. scheme. The Corowa Council has decided to borrow £4,000 for additional plant at its electricity works. The Coburg Council has received sanction to borrow £13,000 for the completion of its E.L. scheme. The Sale Council has decided to take advice on the question of an E.L. undertaking for the district. The Bankstown Council is considering an E.L. scheme, and is arranging to borrow £50,000 for this and other public purposes. The power station which supplied the town of Culcairn with electricity has been destroyed by fire.

Water Power.—The Wairarapa Hydro-Electric Investigation Committee has presented its report to the Government; the scheme is estimated to cost £175,000.

Tasmania.—Electrolytic Zinc.—The chairman of the Electrolytic Zinc Co. states that he is satisfied that all anticipations with regard to the Risdon plant have been realised. The company is to enlarge its works so as to ultimately require 30,000 h.p., which the Hydro-Electric Department has agreed to supply. As opportunity offers, the output will be increased to 100 tons per day. The establishment of subsidiary interests, such as the treatment of zinc oxides, the production of lithophone, and the erection of zinc rolling mills, are being proceeded with.

**Aylesbury.**—L.G.B. Inquiry.—An inquiry was held last week into the application of the T.C. for a loan of £50,500 for extensions to plant at the electricity generating station, and this was amended to £52,500. There was no opposition.

**Bantry (Co. Cork).**—E.L. Scheme.—The Town Commissioners have decided to consider the question of purchasing under compulsion the electrical machinery for the lighting of the town.

**Birmingham.**—Extensions.—The E.S. Committee has decided to erect a sub-station at Bournville, for the supply of electricity for power and lighting, and for the proposed new tramway to Rednal. For the Nechells generating station now being built, a large order for boilers has been given.

**Bradford.**—Electrical Showrooms.—The T.C. has approved the recommendation of the Electricity Committee to purchase, for £16,500, property in Sunbridge Road and Millergate, for the purpose of establishing stores, offices and showrooms. Local traders, especially those in the electrical trade, have contended that the showrooms would become salerooms in unfair competition with the traders. The chairman of the Electricity Committee held that the Committee's policy was one which helped the electrical traders. The Corporation showed everything electrical, and gave local electrical contractors as much discount as it could get from the manufacturers.

**Bury.**—Peace Celebrations.—The Electricity Committee has decided to supply free electricity for illumination purposes on the occasion of the Peace celebrations.

**Canada.**—Water Power.—Government Bills have been introduced in the Nova Scotia Legislature to create a hydro-electric system for the development and distribution of electrical power.—*The Times.*

**Castlerea (Co. Roscommon).**—E.L. Scheme.—The Castlerea Milling and Development Co. is about to introduce a scheme for the electric lighting of the town. The consulting engineers are Messrs. J. P. Tierney & Co., of Dublin.

**Chesterfield.**—Price Increase.—The T.C. has further increased the price of electricity, for all purposes, by 15 per cent. on pre-war charges.

**Crook.**—E.L. Scheme.—The Chamber of Trades has decided to approach the E.L. Co. to see if there is any immediate prospect of electric light being installed in the town.

**Dover.**—Proposed Loan.—The T.C. has applied for a loan for electricity services. Consumers taking electricity by contract are in future to be supplied at ordinary rates for the first 5,000 units, and afterwards at 4½d. per unit, less ½d. rebate, for lighting, 3½d. for power, and 2½d. for heating.

**Dundalk.**—Proposed Mortgage.—As the U.D.C. electricity department is now indebted to the Council to the extent of £7,799, the Town Clerk has been instructed to apply to the Irish L.G.B. for a mortgage of £2,000.

**Dundee.**—Proposed Extensions.—The Electricity Committee has sanctioned a scheme for the extension of the electricity undertaking, involving an expenditure of £250,000. It is proposed to increase the present output by between 60 and 70 per cent. by the installation of four additional multi-tubular boilers, with mechanical draught apparatus and economisers, and two

6,000-kw. turbo-alternators. It is hoped that a portion of the new plant will be in operation within 12 to 15 months, and it is expected that the extensions will carry the department on for two or three years.

**Epsom.**—Expert Advice.—The U.D.C. has decided to engage the services of a consulting engineer to report on the future of the electricity undertaking, and on the installation of Diesel engines in place of the present steam plant.

**Exeter.**—Proposed Price Increase.—The Electricity Committee has recommended the T.C. to increase the charges for electricity to 50 per cent. over pre-war rates.

**Faversham.**—Price Increase.—The T.C. has decided to advance the price of electricity for lighting to the maximum of 7d. per unit, and to apply to the B. of T. for an order to extend the area of supply to Ospringe, Faversham Without, North and South Preston, Davington, Luddenham, and Sheldwick, and for authority to increase the maximum price from 7d. to 10d. per unit.

**Grays.**—Loan Sanction.—The U.D.C. has received sanction to a loan of £600 for electricity mains, services and meters.

**Grimsby.**—Proposed Extensions.—The E.L. Committee has passed estimates for £118,000 for the extension of the electricity undertaking.

**Harrogate.**—Price Increase.—The T.C. has increased the charges for electricity by a further 15 per cent. for ordinary supply, and by 16⅔ per cent. for supplies under the rateable value system.

**Haslingden.**—Bulk Supply.—The Accrington and Rawtenstall T.C.'s have arrived at an agreement for the supply of electricity to Haslingden, and have forwarded the proposals to the Haslingden T.C.

**Hornsey.**—E.L. Charges.—The Middlesex C.C. has withdrawn its opposition to the application of the B.C. for permission to increase its charges for electricity from 8d. to 10d. per unit.

**Irvine.**—Workhouse Lighting.—The directors of Cunningham Combination Poorhouse have agreed to install electricity for lighting and power purposes, at an estimated cost of £1,200.

**Isle of Wight.**—Street Lighting.—The U.D.C. has accepted the offer of the Isle of Wight E.L. Co. for street lighting at Sandown, at £64 per quarter, plus 4½d. per unit, for three years.

**Killarney.**—E.L. Charges.—The U.D.C. has decided to oppose the Kerry E.S. Co.'s application to the B. of T. for permission to increase its charges for electricity from 6d. to 8d per unit.

**Kirkcaldy.**—Proposed Extensions.—The T.C. is considering a scheme for the construction of a new generating station, at an estimated cost of £290,000. A deputation has been appointed to interview Government officials in London on the matter.

**Lerwick.**—E.L. Scheme.—The T.C. is considering the question of lighting the town with electricity in place of gas.

**Lichfield.**—E.L. Scheme.—The T.C. has appointed a Committee to consider a proposal for a supply of electricity for the city from the Wolverhampton T.C.

**Limerick.**—Strike.—Business was interrupted, last week, as the result of a general strike in protest against the town being proclaimed a special military area. Electricity and gas supplies were cut off on April 14th.

**London.**—Woolwich.—Proposed Loan.—The B.C. has decided to apply for a loan of £94,200 for electricity purposes. It is proposed to extend the plant and buildings at Woolwich and to convert the Plumstead generating station into a sub-station.

Bermondsey.—Loan Sanction.—The L.C.C. Finance Committee has recommended that sanction be granted to an application of the B.C. for a loan of £1,209 for electricity mains.

St. Marylebone.—Loan Sanction.—The L.C.C. Finance Committee has recommended that the application of the B.C. for a loan of £22,385 for the installation of two boilers and accessories at the electricity works be granted.

**Ocker Hill.**—Extensions.—The plant of the Midland Electric Corporation for Power Distribution, Ltd., is to be extended by about 12,500 H.P.

**Radcliffe.**—Price Increase.—The U.D.C. has decided to increase its charges for electricity, as from July 1st, as follows: Private and public lighting, 20 per cent., making a total increase of 60 per cent.; small power users on H.P. scale, bioscope arc lamps, and heating, 10 per cent., a total of 60 per cent.; consumers on sliding scale, 10 per cent., a total of 20 per cent., plus operation of the coal clause; consumers on maximum demand, an addition of 05d. per unit to the rent charge, making a total of 1·3d. per unit, plus the coal clause, in addition to £1 per kw.

**Ripon.**—Prov. Order.—The T.C. has decided to apply to the B. of T. for a prov. order for electric lighting in the town.

**Rochdale.**—Year's Working.—The net profit of the Corporation electricity department during the past year amounted to £706; this is to be added to the reserve fund, which now stands at £2,800. The income of £79,235 shows an increase of £4,894, and the expenditure of £52,931, a decrease of £1,371, while last year there was a net deficiency of £3,674. There was a reduction in the cost of coal of £1,500, owing to 2,500 tons less being consumed than in the previous year.

**Rhymney.**—Overhead Wires.—The U.D.C. has consented to the Rhymney Iron Co. utilising overhead wires for the supply of electricity to the district north of the parish church and the church itself.

**Southend.**—New Boiler.—Subject to L.G.B. sanction to the necessary loan, the T.C. has accepted the tender of the Niclausse Boiler Co., at £12,000, for a 30,000-lb. boiler and accessories.

**Southport.**—Price Increase.—The Electricity Committee has recommended increases in the charges for electricity, as follows:—Lighting: Maximum demand system for business premises, from 6½d., 4½d., and 2½d. per unit to 8d., 6d., and 4d.; private houses, flat rate, from 5d. to 7d.; and other purposes, from 1½d. to 2½d.

**St. Anne's.**—Proposed Loan.—The U.D.C. has applied to the L.G.B. for sanction to borrow £13,310, for the purpose of providing plant, cables, &c., in connection with the proposed bulk supply of electricity to Lytham.

**Sunderland.**—National Electricity Supply.—The Electricity Committee has asked the T.C. to pass a resolution of protest against the proposal to transfer the control of electricity supply to the Ministry of Ways and Communications.

**Swinton.**—Price Increase.—The Lancs. E.P. Co. has informed the U.D.C. that the price of electricity supplied in bulk will be increased by 15½ per cent., as from February 1st last.

**Swanscombe.**—E.L. Scheme.—At the monthly meeting of the Parish Council, last week, a letter from the Kent Electric Power Co., relating to the Council's application for electric light for the village, and cost, was read, stating that the company, having no mains near Swanscombe, was not in a position to quote. The Gravesend B.C. desired to know the number of lamps required, also their positions. It would be a help to the B.C. if the number of proposed consumers was secured. The matter was eventually referred to a committee.

**Trim (Co. Meath).**—E.L. Scheme.—The U.D.C. has decided to consider the introduction of an E.L. scheme for the town.

**Warrington.**—Loan Sanction.—The L.G.B. has authorised the T.C. to borrow £11,011 for the purpose of developing the electricity undertaking. The electrical engineer has been instructed to proceed with all applications for lighting installations. Action with regard to prospective demands for power purposes has been deferred, pending an interview with the B. of T.

**Waterville (Co. Kerry).**—E.L. Scheme.—A public meeting has approved of an E.L. scheme for the town.

**Wolverhampton.**—Proposed Loans.—The T.C. has applied to the L.G.B. for sanction to a loan of £25,000 for electricity purposes, as follows:—Mains, £17,500; transformers, £5,000; switchgear, £2,500.

The electricity department is to apply for sanction to a loan of £6,747 for the conversion of premises in Red Lion Street into showrooms.

## TRAMWAY AND RAILWAY NOTES.

**Belfast.**—Tramcars Wrecked.—Following an attempt of 500 shipyard men to board the last three of a long line of tramcars at Castle Junction on Monday last week, the cars became so densely packed that they were unable to move. The police were called, and in the struggle the cars were wrecked.

**Bradford.**—Year's Working.—The financial statement of the Tramways Department for the year ended March 31st, 1919, shows traffic receipts amounting to £451,877, an increase of £89,964 on the preceding year; receipts on the railless service were £15,122, an increase of £2,873; parcels receipts were £11,974, a decrease of £1,156. The number of passengers carried decreased by 7,709,793, the total being 76,419,459. The car-mileage was 5,269,834, a decrease of 635,522. The receipts per car-mile were 22·06d., an increase of 6·12d. The number of units of electricity used for traction was 11,027,312, a decrease of 1,372,202. At present there are an average of 140 cars running, as against the normal 180. Twenty-six new cars are on order.

New Track.—The Tramways Committee has decided to lay new track in the Manchester Road section, at a cost of £52,503.

Tramcar Motors.—The Tramways Committee has decided to order 52 tramcar motors, in addition to 52 ordered a few weeks ago.

**Bath.**—Fare Revision.—The L.G.B. has sanctioned the increase of the tramway fares by 50 per cent.

**Continental.**—Belgium.—Railway Electrification.—A Royal Decree of March 22nd provides for the appointment of a Commission to examine the question of the electrification of railways, and to submit proposals for the execution of the scheme. The projected scheme is to electrify main trunk lines on the overhead trolley system. New carriages and motors would be supplied for the purpose, but trains would be so constructed as to be suitable for steam haulage over non-electrified lines. Carriages would be of the "coupé vent" bogey, metropolitan type, interconnecting, and would have two doors on either side. The object aimed at would be to use trains over scheduled distances—*i.e.*, trains would run backwards and forwards on such routes as Antwerp-Brussels, or Arlon-Ostend. Auxiliary lines might be electrified later. The idea is to use German railway material pending its replacement by new rolling stock.—*Board of Trade Journal.*

**Croydon.**—Conductresses.—Conductresses have disappeared from the Corporation tramways, all having now been replaced by men.

**Dewsbury.**—Extension of Time.—The Corporation has decided to apply to the B. of T. for a prolongation of the periods for the completion of the works authorised by the Dewsbury Corporation Tramways Orders, 1911 and 1912.

**Edinburgh.**—Fare Revision.—The B. of T. has informed the T.C. that it cannot sanction the proposed increase of the tramway fares from 1d. to 1½d. until information regarding the loss which the recent award to tramway employés has been submitted to the Board.

Tramway Electrification.—The T.C. has adopted the recommendations of the Tramways Committee for the electrification of the tramways on the overhead system.

**Farnworth.**—Lightning Accident.—During a thunderstorm, last week, the supply of electricity and the tramway services were disorganised, owing to the generating station and a street cable box being struck by lightning.

**Glasgow.**—Proposed Fare Revision.—The general manager of the Corporation tramway department is advocating the abolition of the 1½d. fare. The wages bill, which was £412,000 in 1913, is estimated at £850,000 for the current year.

**Halifax.**—Year's Working.—The working of the Corporation tramway department for the year ended March 31st last resulted in a net profit of £9,457, compared with £16,887 in the preceding year. The total income was £149,648, against £129,679, and the expenditure was £140,191, against £112,842. Interest and income-tax amounted to £14,480, against £11,968, and sinking fund to £13,392, against £13,265. The car-mileage decreased from 1,869,357 to 1,850,513, while the number of passengers carried increased from 22,822,341 to 24,516,973.

**Keighley.**—Railless Traction.—It is stated that out of 10 railless cars owned by the Corporation, only one is capable of taking the road at present. The cars were made on the Continent, and the lack of facilities to have them repaired is the cause.

**Light Railways.**—Up to December 31st last applications to the Light Railway Commissioners for the sanctioning of schemes under the Acts of 1896 and 1912 represented a total of 5,051 miles of lines. Applications had been granted by the Commissioners for 2,272 miles, while the orders confirmed by the B. of T. authorised the construction of lines aggregating 2,101 miles. Only about 900 miles have, however, been actually constructed, of which 550 are on lands acquired and 350 on roads.

**London.**—Tramway Fares.—The L.C.C. Highways Committee has reported that, in order to meet the increase in working expenses and the extra cost of renewals, it will be necessary to obtain an additional revenue of about £1,000,000 during the current year. The recent reduction of employés' working hours alone will cost £360,000. It is estimated that about £566,000 will have to be raised by increased fares, and that the remainder will be obtained by running 5,000,000 additional car-miles and carrying more passengers. It is proposed to reduce the average length of penny stages from 1·8 miles to 1·5 miles, with a maximum fare of 4d. for a continuous journey, and, as regards workmen's return fares, to charge 2d. for a 2-mile return journey, 3d. for 3 miles, 4d. for 4 miles, and 5d. for journeys over 4 miles. This increase in fares is estimated to produce £416,000, of which £321,000 is in respect of ordinary fares, £55,000 in respect of workmen's fares, and £40,000 in respect of improved methods of fare collection. On the present basis, there is an annual loss of £160,000 on workmen's fares, which, under the new basis, would be reduced to £105,000. The Committee is to reconsider the matter in six months' time, and should the present proposals be insufficient to balance the expenditure and revenue, further proposals will be submitted to prevent the undertaking becoming a charge upon the rates.

The fare increases will come into force, south of the Thames, on Sunday next.

At a meeting of the Council, on the 15th inst., the recommendations of the Committee were carried.

Tube Subways.—Statutory notice is given by the Electric Railway Co. of its intention to apply to Parliament for powers to extend its subway in the Charing Cross district, and to provide exits and approaches in Northumberland Avenue and Victoria Embankment.

Brentford.—At the first meeting of the newly-constituted District Council held on April 17th, the clerk reported that he wrote to the B. of T. pointing out dangerous portions of the tramway track. That letter was sent to the Tramways Co., which had replied that the Council was well aware of the position of affairs under the Tramway Bill of last year. A sum of £400,000 was to be spent on reconstruction, which would be commenced as soon as possible. The surveyor said that he had been assured that three gangs would be kept at work on the track keeping it in order until the reconstruction commenced. The fees of the advisers on the Tramway Bill of last year were £264 and £284 respectively. It was understood that £272 would be paid by the authorities attending the conference. The clerk reported having attended a conference at the B. of T. on the question of the increase of tramway fares, when it was decided that a committee of five should go into the statistics and report. That report had been sent to the B. of T., which would consider it. The chairman said that he thought the fares would go up; the Tramways Co. had pressed for higher fares in order to carry on. No decision had been given by the B. of T.

Derailments.—Late at night on Friday last a tramcar failed to take the points at Kew Bridge, and was derailed. Traffic was held up for some time. On Monday morning another car at the same spot jumped the metals and fouled a passing car, slightly damaging it.

**Manchester.**—Estimates.—The estimates which the Tramways Committee has submitted to the T.C. show that wages have increased by £400,000 per annum, or 117 per cent., over pre-war rates. During the past five years the number of passengers carried has increased from 200 to 250 millions. Last year £111,000 was contributed from the receipts to the city fund, and £109,000 was added to the renewals fund.

**Northampton.**—Working Hours.—The application of the tramway employés for permission to work their eight hours' day without a break has been acceded to by the Tramways Committee, and employés will take their meals on the cars.

Power for Tramways.—The Tramways Committee has recommended the T.C. to accept, for a period of five years, the offer of the E.L. and P. Co. to supply electricity for the tramway service. It is now estimated that the annual saving will be £2,000 per annum.

**Pontypridd.**—Year's Working.—The past year's working of the Corporation tramway undertaking resulted in an increased revenue of approximately £8,932. The receipts were £37,236, against £28,303 in the previous year, and passengers carried numbered 7,202,402, against 6,642,399.

**Rochdale.**—Year's Working.—The past year's working of the Corporation tramway department resulted in a surplus of £662; this it is proposed to place to the renewals fund, which now stands at about £32,270. The total income for the year was £118,033, an increase of £9,561. Working expenses were £60,710, an increase of £4,118, and other charges £58,596, an increase of £13,767, of which £11,516 was increased war bonus, and £1,787 increased income-tax. Last year's profit was £8,351. The capital outlay on the undertaking now totals £368,214.

## TELEGRAPH AND TELEPHONE NOTES.

**Argentina.**—A wireless concession has been granted to the Siemens firm, under date March 15th, on behalf of the Berlin Co. owning the Telefunken system. The concession is for 30 years, commencing on the date of the approval of the plans, and is solely for foreign messages. Power will be supplied by 400-kw. high-frequency Telefunken machines; the wave lengths will be 10,000 metres and upwards. The tariff between Argentina and Germany is to be two-thirds less than cable rates, and the tariff for all Government services 50 per cent. less than the public charges. The State reserves the right to exact that all the employés shall be Argentinos. The concession does not give the company a monopoly. The company has three months in which to present the general and 12 months in which to present the definite plans. A public service is to be given within two years.

**Belgium.**—When the Germans destroyed the telephone system of the country, they calculated that it would take two years to restore it. The two chief central exchanges at Brussels were entirely removed, and the third was destroyed. The heads were cut off 50 underground cables, each made up of from 200 to 400 wires, while separate wires were cut in several places in such a way as to make them especially difficult to repair. Equipment was torn down and removed; one of the big "multiples" was entirely destroyed. The whole telephone installation will have to be rebuilt; the work is going on.

Exchanges in other towns have suffered the same fate. The wires in private houses have been cut, and in many cases the

instruments have been removed. The same conditions prevail at the Central Telegraph Office. The great switchboard serving as an exchange for the whole of the country was stripped. The main instrument room was left simply empty. At the end of last month there was *no* cable communication with England, except by way of Holland and France. There was only one wire working between the French frontier and Paris. It was four-and-a-half months before the Germans succeeded in discovering, although it had been laid by Siemens, how the Belgians had managed to keep the underground telephone line from Antwerp working surreptitiously for days after the occupation.—*The Times.*

**Cable Censorship to be Withdrawn.**—The daily Press states that as the outcome of an agreement between the Allied Governments, the censorship on all cable communication between Allied and the Orient and S. American and European countries, excepting Germany, Austria and Hungary, and that part of Russia controlled by the Bolshevists, is about to be withdrawn. Formal approval of the British Government has not been given to the agreement; but it is expected to be notified this week.

**Germany.**—A report from Paris states that the Associated Governments have authorised the resumption of postal, cable, and wireless communication between Germany and neutral countries to a limited extent, in order to facilitate the Brussels Food Agreement of March 14th. Communications regarding imports are confined to foodstuffs, and those regarding exports may not contain references to forbidden articles. All correspondence will be censored, and wireless will only be permitted if Germany consents to the setting-up of central censorship machinery.

According to a Press correspondent, it is said that it has now been decided that the following cables will not be restored to Germany:—Emden-Vigo; Emden-Brest; Emden-Teneriffe; Emden-Azores (two lines); Azores-New York (two lines); Teneriffe-Monrovia (West Africa); Constantinople-Constanza; Monrovia-Pernambuco (Brazil); Chifu-Tsingtau-Shanghai; Yap (Caroline Islands)-Shanghai; Yap-Guam (Pacific); Yap-Menado (Malay Archipelago).

**India.**—During disturbances the rioters at Amritsar cut the telegraph lines, and at Ahmedabad the city telegraph office was burned down. Destruction of the railway and telegraph lines is said to be, perhaps, the most distinctive feature of this widespread disturbance, as was the case also in Egypt.

**Isle of Man.**—The telegraph service between the Isle of Man and the mainland, interrupted by a breakage of the submarine cable, has been restored. Since the breakage took place on February 25th, communication has been maintained by wireless.

**Spain.**—The Government is making every effort to re-establish telegraphic and telephonic communication, which ceased at midnight on April 18th, owing to a political strike.

A later *Times* report states that the Cabinet has approved a Bill making it a penal offence for telegraphists to leave work. Official communications have been restored in the principal Provinces. Several provincial capitals where the telegraphists are still at work are able to communicate with each other and with the different localities in their respective districts.

**Telegraph Operators.**—At the first conference of the Cable Telegraph Operators' Association, held in London on Saturday last, a programme was decided upon which includes a six-hour day, optional overtime, revision of the pension scheme, voluntary retirement at 50 and compulsory retirement at 55, and equal pay for equal work irrespective of sex.

**Underground Telephone Cables.**—Two of the schemes for placing all the telephone wires of Leeds and district under ground are already in hand. The general scheme, planned before the war, includes, besides many big centres, practically the whole of the wires acquired from the National Telephone Co. in 1912. Practically all the plans have been made, and all the contracts made for the underground schemes. The greater part of the underground cable in Leeds itself will also be down before the end of 1919. It is estimated that the whole programme will take between two or three years to complete. The first important underground telephone cable to be started upon was the one to London, but this will not be the first one to be completed.—*The Times.*

**United States.**—Restrictions in the United States upon the use of wireless receiving stations, other than those for commercial traffic, were to have been removed on April 15th.

Organised telegraph and telephone workers are taking a vote, to be completed by May 5th, on the question of a general strike.—*The Times.*

**Wireless Operators' Threat.**—Regarding the wireless operators' threat to strike unless payment was made of the £3 a month war-risk bonus, the Shipping Controller held a conference with representatives of the Shipping Federation and the Marconi Co. at the Ministry of Shipping on April 14th, and a decision was come to, which, however, the men's association regards as not altogether satisfactory.

The Marconi Co. has granted the demands of the Association of Wireless Telegraphists for the payment of the bonus to date back from October 7th last.

**Wireless Restrictions Removed.**—The ban on all wireless messages for the public is to be removed on May 1st, Mr. Godfrey Isaacs stated at a meeting of the Marconi Co. last week. From that date wireless installations on all vessels will be reinstated.

# CONTRACTS OPEN AND CLOSED.

*(The date given in parentheses at the end of the paragraph indicates the issue of the* Electrical Review *in which the "Official Notice" appeared.)*

## OPEN.

**Australia.**—Brisbane.—May 15th. Department of the Treasury. H.T. switchboard, storage battery and motor-generator set for the electric power house, Inkerman Irrigation Area, Townsville. Specifications from the Hydraulic Engineer, Brisbane.

June 18th. Brisbane City Electric Light Co. Supply of rotary converters (specification 10a. 6d.) from the offices of the company at Brisbane.—*Tenders.*

Melbourne.—May 14th. Victorian Railway Commissioners. Cells, renewals, caustic soda and mineral oil for caustic soda batteries. (Contract No. 32,194.)

Sydney.—June 9th. City Council. Supply and erection of power-house switchgear. Specifications from Electric Lighting Department, Town Hall, Sydney.*

**Bedford.**—May 3rd. Electricity Department. Meters for 12 months. (April 18th.)

**Birr (King's County).**—May 1st. Birr Electric Light and Power Co., Ltd. Hydraulic turbine and accessories, electric generator, reducer set and motor booster, switchboards, alterations to P. & G. storage battery, overhead distributing lines, wooden poles and fittings. (April 11th.)

**Chorley.**—April 28th. B. of G. Electric lighting installation at the Poor Law Institution, Eaves Lane, Chorley. Specification from Mr. R. E. Aspden, Clerk, 7, High Street, Chorley.

**Dundalk.**—April 29th. U.D.C. Electricity Department. Replating of storage battery. (April 11th.)

**Ilford.**—April 26th. Tramway Committee. 100 tons steel tramway rails, 140 pairs fishplates and fishbolts, 300 copper rail bonds, 28 tramway standards.—Mr. L. Harvey, Tramways Office, Ley Street, Ilford.

**London.**—Battersea.—May 1st. Electricity Department. One water-tube boiler, superheater, economiser and mechanical stoker, induced-draught plant for main flues. (April 11th.)

L.C.C.—May 12th. 5,000 driving-wheel tires, and 3,500 trailing-wheel tires for electric tramways. General Manager, L.C.C. Tramways, 23, Belvedere Road, Lambeth, S.E.

Metropolitan Water Board.—May 22nd. Two Diesel engines, gearing and centrifugal pumps. Chief Engineer's Department, South Place, Finsbury Pavement, E.C.

**Salford.**—1,000 yd. of i.r. insulated electric cable, and one 20-B.H.P., D.C. electric motor. Particulars from Mr. W. Woodward, Engineer, Gas Offices, Bloom Street.

**South Shields.**—April 29th. Corporation. Rails, copper rail bonds, bonding of rails. Particulars from Mr. J. C. Whiteby, tramway manager.

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development & Intelligence), London.

## CLOSED.

**Australia.**—Melbourne.—City Council:—

Five electric motors, £423.—British General Electric Co., Ltd.
Six circuit breakers, oil brake type, £315.—Warburton, Franki, Ltd.

P.M.G.'s Department, N.S.W.—
20,000 porcelain insulators, £594.—Firebrick Insulator & Pottery Co. (Pty.), Limited.

P.M.G.'s Department, Queensland—
10,000 porcelain insulators, £297.—Firebrick Insulator & Pottery Co. (Pty.), Limited.
Material for automatic telephones, £404.—B.I. & Helsby Cables, Ltd.

P.M.G.'s Department, Tasmania—
3,000 porcelain insulators, £89.—Firebrick Insulator & Pottery Co. (Pty.), Limited.

Prime Minister's Department—
One induction motor for ship construction purposes, £405.—Noyes Bros. (Melbourne), (Pty.), Ltd.

Victorian Railways Department—
Electric lamps, 600 c.p., 240 volts, gas-filled screw caps, 14s. 3d. each; 300 c.p. do., bayonet cap, 11s. each; 200 c.p. do., 7s. 6d. each; 400 c.p., 230 volts, 12s. 5d. each; 16 c.p., carbon filament, 240 volts, 1s. 4d. each.—Noyes Bros. (Melbourne), (Pty.), Ltd.—*Tenders.*

**Barnsley.**—T.C. Switchgear. New Switchgear Construction Co., £159.

**Glasgow.**—Tramways Department:—

Axles.—Glasgow Railway Engineering Co., Ltd.
Phono trolley wire.—Bridgeport Brass Co.
Galvanised steel wire.—Whitecross Co., Ltd., and J. Stewart & Co., Ltd.
Drop forgings for jacks.—A. Harper, Sons & Bean, Ltd.
Commutators.—P. R. Jackson & Co.

**Government Contracts.**—The undermentioned contracts were placed during March, 1919:—

War Office.

Spares for generating sets.—M. L. Magneto Syndicate, Ltd.

Post Office.

Protective apparatus.—Automatic Telephone Manufacturing Co., Ltd.
Telegraph apparatus.—Creed & Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Peel-Conner Telephone Works, Ltd.; Telephone & Microphone Co.; Western Electric Co., Ltd.
Submarine cable.—Siemens Bros. & Co., Ltd.
Telegraph and telephone cable.—Western Electric Co., Ltd.
Jointing compound.—Dussek Bros. & Co., Ltd.
Cords for telephones.—London Electric Wire Co. & Smiths, Ltd.; Phœnix Telephone & Electric Works, Ltd.
Stoneware ducts.—Albion Clay Co., Ltd.; Gibbs & Canning, Ltd.; H. R. Mansfield; G. Skey & Co., Ltd.; Sutton & Co.; T. Wragg & Son, Ltd.
Lamps for telephones.—General Electric Co., Ltd.
Laying conduits.—Sevenoaks-Tunbridge Wells, R. M. Parkinson; Motherwell-Hamilton, W. Dobson; Motherwell, W. Dobson.
Manufacturing, supplying, drawing-in, and jointing cables.—London-Stanmore corner, Callender's Cable & Construction Co., Ltd.; Glasgow-Motherwell, Siemens Bros. & Co., Ltd.; Liverpool-Manchester, W. T. Henley's Telegraph Works Co., Ltd.
Amplifying valves.—Marconi Wireless Telegraph Co., Ltd.

India Office—Stores Department.

Accumulators.—Chloride Electrical Storage Co., Ltd.
Boiler tubes.—A. Everitt & Sons; W. Baylis, Ltd.
Cable.—W. T. Glover & Co., Ltd.; General Electric Co., Ltd.
Generating sets.—Lancashire Dynamo, &c., Co., Ltd.

H.M. Office of Works.

Engineering works.—Electric wiring, Ministry of Pensions, Regent's Park, Tredegars, Ltd.

Board of Public Works, Dublin.

Electrical work and supplies, Dublin District.—Handley & Robinson.

**London.**—Poplar.—Electricity Committee. Recommended :—

One boiler, 36,000-lb. evaporative capacity, complete, £11,758.—Clarke, Chapman & Co., Ltd.
Rotary feed pump, £657.—G. & J. Weir, Ltd.
Seven patent automatic coal weighers, £2,363.—W. & T. Avery, Ltd.
One balancer-booster set, complete with spare parts, with starter and regulator, £1,287.—Mather & Platt, Ltd.
Renewing existing battery, £248.—Hart Accumulator Co., Ltd.

**Taunton.**—T.C. Three electric vehicles. Edison Accumulator Co., Ltd., £1,304 each, one with interchangeable body, £300 extra.

## FORTHCOMING EVENTS.

**Society of Technical Engineers (North-Western District).**—Friday, April 25th. At 7.15 p.m. At Milton Hall, 244, Deansgate, Manchester. District mass meeting.

**Junior Institution of Engineers.**—Friday, April 25th. At 7.30 p.m. At 39, Victoria Street, London, S.W. "Commercial Flying," by Mr. J. D. North (of Boulton & Paul, Ltd.).

Friday, May 2nd. At 7.30 p.m. At 39, Victoria Street. Lecturette on "Engineering at the Front," by Capt. G. B. Paterson, A.I.F.

**(North-Eastern Section).**—Tuesday, April 29th. At 7.15 p.m. At the Mining Institute, Newcastle-upon-Tyne. Paper on "A.C. Diagrams and their Systematic Development," by Mr. M. M. Hall.

**Industrial Reconstruction Council.**—Tuesday, April 29th. At 5.30 p.m. At the Institute of Journalists, Tudor Street, E.C. Conference on "Incentives to Efficiency in Scientific Management," to be opened by Mr. H. Atkinson.

**Institution of Civil Engineers.**—Tuesday, April 29th. At 5.30 p.m. At Gt. George Street, Westminster, S.W. Annual general meeting.

**Faraday Society and the Roentgen Society.**—Tuesday, April 29th. From 5 to 7 p.m. and 8.30 to 10 p.m. Joint meeting. At Burlington House, Piccadilly, W. (See "Institution Notes" this issue.)

**Royal Society of Arts.**—Wednesday, April 30th. At 4.30 p.m. At John Street, Adelphi, W.C. "Trueman Wood" lecture on "Glass and some of its Problems" by Sir H. Jackson, F.R.S.

**Royal Institution of Great Britain.**—Friday, May 1st. At 5.30 p.m. At Albemarle Street, W. Lecture on "Energy Distribution in Spectra," by Prof. J. W. Nicholson, F.R.S.

**Institution of Electrical Engineers.**—Thursday, May 1st. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Lecture on "Magnetic Storms," by Dr. C. Chree, F.R.S.

**North-Eastern Centre).**—Monday, April 28th. At 6.45 p.m. At the Mining Institute, Newcastle-upon-Tyne. Lecture on "Electric Welding," by Dr. J. H. Paterson.

**(North-Midland Centre).**—Tuesday, April 29th. At 7 p.m. At the Metropole, King Street, Leeds. Papers on "Electric Furnaces."

**Institution of Mechanical Engineers.**—Friday, May 2nd. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "The Mechanical Properties of Steel, with some Consideration of the Question of Brittleness," by W. H. Hatfield.

## NOTES.

**Government Pledges to Labour.**—In the House of Commons last week the Minister of Labour (Sir Robert Horne) presented the "Restoration of the Pre-War Practices" Bill. We print below the four opening paragraphs :—

1.—(1) Where, in any establishment to which this Act applies, any rule, practice, or custom obtaining before the war in any industry or branch of an industry (hereinafter referred to as a trade practice) has, during and in consequence of the present war, been departed from, the owner of that establishment shall be under an obligation, at the expiration of one month from the date when such notice as is hereinafter mentioned is served on him, to restore or permit the restoration of the trade practice so previously obtaining, and for one year after such restoration is effected to maintain or permit the continuance of the trade practice.

(2) Where any industry or branch of industry, which before the war was not carried on in an establishment, commenced to be carried on in the establishment during the war and continues to be carried on therein after the termination thereof, or where an establishment is one which commenced to be worked after the beginning of war, the owner of the establishment shall be under the obligation, at the expiration of one month from the date when such notice as is hereinafter mentioned is served on him, to introduce or permit the introduction of, and for one year after such introduction is effected to maintain, or permit the continuance of, such trade practices as obtained before the war in other establishments where that industry or branch was carried on under circumstances most nearly analogous to those of the establishment in question.

(3) An obligation under this section shall not become binding on the owner of any establishment unless within three months after the termination of the war there is served on the owner by or on behalf of a majority in the establishment of the class or grade of workers whose custom it was before the war to maintain the trade practice in question, a notice in the prescribed form requiring the observance of the obligation, and specifying the nature of the practice to which the obligation relates, and if the change of practice was made in pursuance of an agreement, specifying also the agreement.

(4) If the owner of the establishment is not prepared to comply with the notice or is in doubt as to the nature of the trade practice to be restored or introduced, he shall within 14 days from the service of the notice on him serve on the sender of the notice a counter notice in the prescribed form to that effect.

The full copy of the text of the Bill was printed in the *Times* on April 21st. The Act will apply to establishments in which munitions work within the meaning of the Munitions of War Acts, 1915 to 1917, has been carried on, and any other establishment in which the departure from the practice was made in consequence of the agreements; also to Crown establishments.

**Educational.**—The British Science Guild has issued a memorandum urging the Government to appoint a Departmental Committee to inquire into the provision for University and higher technical education in this country, and a Consultative Committee, consisting mainly of representatives of industry, to advise the Board of Education on matters affecting the relationship of science and industry to education.

**Scientific Research in Canada.**—A resolution for the appointment of a Special Committee to consider scientific research has been adopted by the Canadian House of Commons.—*The Times.*

**Institution and Lecture Notes.—Joint Meeting of the Faraday Society and the Röntgen Society.**—A general discussion on "The Examination of Materials by X-rays" will be held on Tuesday, April 29th, in the rooms of the Royal Society, Burlington House, London, W. 1, from 5 to 7 and from 8.30 to 10 p.m. The chair will be taken by Sir Robert Hadfield, Bart., F.R.S., President of the Faraday Society, who will introduce the discussion.

Prof. W. H. Bragg, C.B.E., F.R.S., will deliver an address on "Radiometallography."

Prof. Alfred W. Porter, F.R.S., will give short abstracts of the following papers,* translations of which will be presented by Sir Robert Hadfield :—(*a*) "Investigation of Metals by Means of X-rays," by F. Janus (Munich) and M. Reppchen (Cologne). (*b*) "The Principles Governing the Penetration of Metals by X-rays," by Dr. G. Respondek (Helensee).

M. H. Pilon and Mr. Geoffrey Pearce will give a brief description of the "Apparatus Used for Radiometallography," illustrated by lantern slides.

Capt. R. Knox and Major G. W. C. Kaye will present a paper on "The Examination of Timber by X-rays."

Sir Robert Hadfield, Bart., F.R.S., Mr. S. A. Main, B.Sc., and Mr. J. Brooksbank, B.Sc., A.R.C.S., will read papers on :—(*a*) "Testing the Absorption Power of Different Steels under the X-rays"; (*b*) "X-ray Examination as Applied to the Metallurgy of Steel"; (*c*) "Radiographic Examination of Carbon Electrodes Used in Electric Steel-Making Furnaces"; (*d*) "A Method of Testing an X-ray Tube for Definition."

Lieut.-Colonel C. F. Jenkin will contribute a note on "The Detection of Hair Cracks in Steel by Means of X-rays."

Mr. F. F. Renwick will read a paper on "The Behaviour of Photographic Plates Exposed to X-rays, Considered in Relation to the Radiography of Metals."

Dr. R. E. Slade will read a paper on "Contrasts in X-ray Photographs."

M. E. Schneider (Le Creusot), President of the Iron and Steel Institute, will present a paper on "Radiometallography."

Prof. A. W. Hull, Mr. C. T. Heycock, F.R.S., Mr. A. A. Campbell Swinton, F.R.S., Mr. F. W. Willcox, Capt. Leslie Aitchison, Mr. Donnithorn, and others will contribute to the discussion.

Major C. E. S. Phillips will exhibit apparatus used at the War Office X-ray Laboratory for testing definition of X-ray bulbs.

Exhibits and demonstrations will also be given by M. Pilon, Messrs. Newton & Wright, Watson & Sons, Cox & Co., and the British Thomson-Houston Co., Ltd.

* Proofs on application to Sir Robert Hadfield, 22, Carlton House Terrace, S.W. 1, or to the Secretary of the Faraday Society

**Institution of Electrical Engineers.**—On April 14th, the second informal meeting of the Institution was held, Mr. R. Rankin presiding. Dr. R. D. Gifford introduced a discussion on "Electrical Instruments," with an excellent review of the principal types in general use, describing the leading features of each type briefly but clearly, and maintaining an attitude of impartiality which drew a high compliment from a well-known instrument maker in the subsequent discussion. In the course of his paper, Dr. Gifford was greatly assisted by the "mirrorscope," in the hands of Mr. W. E. Bradshaw, by means of which the images of drawings and diagrams were projected on a translucent screen. As a feat of condensation without loss of breadth the paper left nothing to be desired.

The attendance was not so good as at the first meeting, but the discussion was well maintained. The chairman described a hunt with a Megger for an intermittent earth at a public institution, which eventually became a dead earth and was localised in the mortuary! A naval officer gave interesting details of his experience with instruments on warships, urging that they should be provided with brass cases instead of cast-iron, because the *matelot* was taught to paint everything except brass, and consequently he painted the ironclad instruments black—including the glass. Another speaker remarked that this did not really matter, as delicate instruments were speedily put out of order on board ship, and might just as well be blacked over. The pranks of beetles and spiders in the interior of electricity meters were described, and one speaker gave an account of a meter which first refused to start, afterwards refused to stop, and finally, when left going all night, gave no record; it was eventually found that the meter stopped soon after the staff left the test room, and started again next morning just before they arrived, this behaviour being due to the fact that a motor in an adjoining room stopped and started at those times, and the vibration caused by the motor reduced the pivot friction just enough to allow the meter to run. Another naval officer described some measuring instruments employed in connection with wireless telegraphy. Altogether the meeting was thoroughly successful.

The annual general meeting of the Scottish Centre of the I.E.E. was held at Glasgow on April 8th, Mr. J. F. Nielson in the chair. The new Committee was elected, as follows:—

Chairman.—Mr. W. B. Hird.

Vice-Chairmen.—Messrs. Alex. Lindsay and J. E. Sayers.

Past-Chairmen (*Ex-Officio* Members of Committee).—Messrs. J. K. Stothert, Arch-Page, J. F. Nielson.

Chairman of Students' Section.—Mr. F. H. Whysall.

Ordinary Members of Committee.—Messrs. Sam Mavor, E. T. Goslin, A. S. Hampton, W. Wood, R. B. Mitchell, Frank Anslow, W. J. Belsey, Capt. J. M. Scott-Maxwell, Messrs. J. A. Bell, John Prentice, D. S. Munro.

Hon. Sec. and Treasurer.—Mr. Joseph Taylor.

Assist. Hon. Sec.—Mr. Wm. F. Mitchell.

The annual report showed that while the average attendance this session had not been large, the Committee was satisfied that much good work had been done. The discussions had showed that interest was generally well maintained. A proposal was at present before the Council to hold special summer or autumn meetings at Aberdeen and Dundee, with a view to interesting residents in those neighbourhoods. The session ended with a total membership of 380, an increase of 31 on the previous year. In moving the adoption of the report the chairman said that no definite arrangements had yet been made for the special meeting at Dundee, but it had been practically decided to meet at Aberdeen on June 6th. That meeting would take the place of the summer meetings they had had in the past. The meeting would be purely a Scottish Centre meeting, and there were hopes that the president of the Institution (Mr. Wordingham) would be present. Details would be announced later. The report was adopted, and Mr. M. B. Field gave a lecture on the "Navigational (Magnetic) Compass as an Instrument of Precision."

**Royal Institution.**—The lecture arrangements for after Easter, include the following:—

Friday, May 2nd. At 5.30 p.m.—"Energy Distribution in Spectra," by Prof. J. W. Nicholson, F.R.S.

Friday, June 6th. At 5.30 p.m.—"Atomic Projectiles and their Collisions with Light Atoms," by Prof. Sir Ernest Rutherford, F.R.S.

Tuesdays, May 27th and June 3rd. At 3 o'clock.—"Listening Under Water," by Prof. W. H. Bragg, F.R.S.

Thursdays, May 1st and 8th. At 3 o'clock.—"Clutches," by Dr. H. S. Hele-Shaw, F.R.S.

Saturdays, May 3rd and 10th. At 3 o'clock. "Chapters in the Psychology of Industry," by Prof. H. S. Foxwell.

**Birmingham Electric Club.**—At the final meeting of the session, on April 12th, a paper was read by Mr. J. Gold upon "Electric Converting Plant," in which the author gave an account of the theory, design, and practice of the three principal types at present in use—the motor-generator, the "La Cour" motor converter, and the rotary converter. The design, construction, and performance of each type were fully discussed, together with the modification in design of rotary converters, their installation, starting up, and control. Test figures were given of three types under varying loads. In each case the rotary converter had an advantage in efficiency over the other two; and as the initial costs were also lower, the author held it proved that the future lay entirely with the rotary converter.

**Institution of Civil Engineers.**—At the meeting of the Institution on April 9th, a paper was read by Mr. George Hughes on the electrical and mechanical equipment of the all-metal cars of the Manchester-Bury section of the Lancashire and Yorkshire Railway. In the motor bogie, he said, the best locomotive practice had been adopted, and the design was the outcome of the development of the built-up frame bogie. Each bogie was fitted with two motors, geared to the axle through spur gearing. The motors were 200-H.P., and had been designed on the experience gained on the Liverpool and Southport line. The temperature rise of these motors was 55° C. after an hour's run at full load.

The vacuum brake equipment was of the simplest possible form. In the design of the brake valve the "dead man's" handle was incorporated, which applied the brakes and cut off current to the main motors. The motors, of 5-H.P., for driving the pumps were series wound, and ran at 1,000 R.P.M. on a 100-volt circuit. This pump was operated through a switch in the brake valve and an automatic regulator.

**Association of Mining Electrical Engineers.**—At a meeting of the Yorkshire Branch, at Leeds, on April 12th, a paper on "Some General Types of Electrical Apparatus" was read by Mr. Fred Sims. In reference to the relations existing between colliery managers and electricians, Mr. Sims said that in quite a number of cases the electricians were looked upon as a "necessary evil" by the managers, and treatment was meted out to them accordingly. Mutual sympathy and understanding were in the highest degree necessary for the smooth working of the plant, and especially with regard to the colliery electrical apparatus. The present condition of affairs was deplorable, and he trusted that in the near future suspicion and jealousy would be removed, and a real and lasting amicable understanding would be instituted.

Irish Water-Power Resources.—In a lecture by Mr. H. N. Walsh, under the auspices of the Commerce Society, University College, Cork, a list of sites was given showing that there were very few places in Ireland at which electricity might not be generated for transmission to the cities, or for electrochemical purposes. Many of these, said Mr. Walsh, were suitable for all kinds of factories requiring up to 500 or 1,000 H.P., and there were districts all over the country where power could be got from streams for working flour and woollen mills and farm machinery. Particulars were given of places in South Kerry where power ranging from 25 to 250 H.P. was available for a 10-hour day in a very dry season, and it was pointed out that in a number of cases facilities were available for storing winter floods, and using the excess water to augment the summer supply.

**U.S.S. Tennessee.**—What is described as the world's largest battleship, the U.S.S. *Tennessee*, which is to be electrically propelled, will be launched at Brooklyn, U.S., next week.

**Appointments Vacant.**—Charge engineer (75s.), for the Coventry Corporation tramways; shift engineer, for the Birkdale and District Electric Supply Co., Ltd.; junior shift engineer (£186), for the Crewe Corporation Electricity Works; assistant electrical engineer (£300 + £120), for the Government of Nigeria; junior mains assistant, for the Leith Corporation Electricity Department; shift engineer (79s.), meter tester and repairer (71s. 6d.), cable jointer (69s. 6d.), for the Dewsbury Corporation Electricity and Tramways Department; instructor for test room work (£5), assistant instructor (70s. to 80s.), for the Erith Technical Institute; shift engineer, for the Kingston-on-Thames Corporation Electricity Department; charge engineer (£214), for the Heston and Isleworth U.D.C. Electricity Works; chief electrical engineer (£800), for the Corporation of Southampton Electricity Department; cable jointer, for the Borough of Haslingden Tramways Department. See our advertisement pages to-day.

**Fire at the House of Commons.**—On Tuesday last, a slight fire occurred in a corridor of the House of Commons, due to the ignition of an electric fuse-box. No serious damage was done.

**The Threatened Lock-out.**—In order to avoid a rupture in the dispute with regard to the employment of non-union men, the employers sent a circular to every member of the Electrical Trades Union, stating the facts. Mr. Leonard Tate, Secretary of the London Masters' Association, said that his Association was anxious to arrive at an amicable settlement of the dispute, and would go a long way towards meeting the wishes of the men. The Union is opposed to the employment not only of non-union men, but also of members of the National Association of Supervising Electricians, and declares that Rule 1 of the London working rules, which is relied upon by the employers, was never formally accepted by the Union. A mass meeting of the men was held on Wednesday last week, when Mr. J. Rowan, general secretary, and other members of the executive attended; about 2,000 members were present. It was decided to continue the strike at Messrs. Rushleigh Phipps & Co.'s works.

**Fatalities.**—It is reported that Clarence Oxley, aged 21, an employé of the Appleby Iron Co., Ltd., was found at Gooseholme grasping an electric wire (220 to 250 volts), which had been fixed 25 ft. from the ground, but had broken and fallen.

The *Times* reports that in a boating accident on the River Crouch, on Monday, J. G. and P. Teasdale, aged 19 and 18 respectively, sons of Mr. J. H. Teasdale, electrical engineer, of Althorne and London, were drowned.

**Electric Furnaces for Mexico.**—Electrical furnaces, it is said, are destined to become one of the chief items of electrical export from the U.S.A. to the Spanish-speaking countries. This is true, according to the *Electrical World*, because of the large amount of low-priced scrap metal there available, and the abundant supply of hydro-electric power in most of those countries. Ten Bailey brass furnaces, of the tilting type, and rated at 105 KW., 1,500 lb. hearth capacity, and 600 lb. per hour melting rate, formed a recent shipment to Mexico.

**Submarine Detection by Wireless.**—An interesting account was recently given in the *Times* of the part played by the flying boats stationed at Harwich in the detection and destruction of enemy submarines. Incidentally it may be mentioned that it was at Harwich that the hydrophone for detecting submerged submarines was evolved. Flying boats were, of course, fitted with wireless equipment, and it was by this means that the presence of enemy submarines was revealed. When they reported to Germany by wireless the signals were picked up by two widely separated direction-finding stations in England, which each obtained a bearing of the submarine. The base line between the two English stations was known, and when the two bearings were plotted out, a triangle was formed, and the apex, where the two bearings crossed, gave the exact position of the U-boat. But the submarine took few chances in sending these signals. The two jumping wires which ran from end to end of the boat, passing over the conning tower, and forming a protection against nets, hawsers, and mines, were fitted as an auxiliary aerial, and therefore the submarine could wireless without setting up an aerial mast, and was in trim to dive immediately if any danger threatened. The Zeppelin patrols were carried out on orders direct from the Admiralty, the position, course, and speed of the aircraft being determined by wireless methods in the same way as the submarines were spotted. Besides this work the flying boats carried out long reconnaissances from lighters, which could be towed behind destroyers. In order to keep the engines of the flying boats dry and warm, special padded covers were made and electric heaters fitted. The heating current was supplied from the destroyers to the lighters through waterproof cables. In the same manner electric heating was provided in the cramped cabins in the bows of the lighters used by the crews.

The destruction of the wireless station, which intercepted messages about the movement of U-boats, was the object of the German submarine's bombardment of St. Kilda, Outer Hebrides, in May last year. The submarine fired 4-in. shells and battered the wireless station to ruins. Before leaving the island the Germans landed marines to make sure that the destruction of the station was complete. The station was rebuilt.

**Hydro-electric Power Development in Portugal.**—A recent American commerce report notes that a movement is on foot for the utilisation of the hydroelectric power in the whole of Portugal. The number of applications for concessions pending would imply an expenditure of not less than £10,000,000 in plant, but most of these are nothing further than an expedient form of acquiring rights and eliminating competition. As regards the north of Portugal, three great electric power systems are to be considered, viz.: (1) the International Douro, where this river divides Portugal from Spain, 300,000 to 400,000 H.P.; (2) the Portuguese Upper Douro, 60,000 to 100,000 H.P.; and (3) the Upper Cavado, 40,000 to 60,000 H.P. All the above are more or less under study and negotiation, but so far as can be ascertained nothing of a definite character has been concluded. The international Douro scheme is dependent on some arrangement with the Spanish Government, while the national Douro system more or less competes with the former. The Upper Cavado remains strictly Portuguese in nature, and is situated close to one of the most important tungsten mines in the world, worked by a Belgian concern. Work on a fourth system, the upper Lima at Lindoso, where this river enters Portugal, is well advanced. A 10,000-H.P. turbine of Swiss manufacture is installed and the company is now waiting for electric machinery purchased in the United States. This concession is in the hands of an important Spanish company, and will prove valuable since it immediately serves a densely populated province where many new industries can be introduced, and a system of electric railroads established with all prospects of success. About a dozen other minor electrical units are available in the north of Portugal, of which one or two are already in operation. It will be remembered that our special correspondent in Spain referred to the River Douro Co.'s operations in the Electrical Review for April 11th, 1919, p. 427.

**Accurate Timing in Electrical Tests.**—In conducting short-time tests of electrical apparatus it sometimes happens that the precision of the apparatus under test exceeds that of the ordinary stop watch with which the test is made. In such a case, unless the observer is on his guard, the error he may assign to the apparatus may be mainly attributable to the unsuspected error of his timekeeper. This possibility is clearly presented in an article in the *Electrical World* by Prof. F. A. Kartak. Two methods of obviating the difficulty are described, one involving an improved form of stop watch, the other a cycle counter converted into the equivalent of an accurate timekeeper through the intervention of a carefully-adjusted tuning fork. It is certain that electrically driven forks are coming into more generally recognised use. A tuning fork, properly constructed, is a wonderfully reliable timekeeper, and, unlike an ordinary pendulum, its frequency is nearly independent of its amplitude of vibration unless the amplitude is unusually large. The precision in time obtainable with tuning-fork control is easily one part in a thousand, and without much difficulty can be raised to one part in ten thousand. With the stroboscopic fork, which is another well-known laboratory adjunct, the precision with which a steady speed of rotation can be measured is also of the third or fourth order.

## OUR PERSONAL COLUMN.

***The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.***

**Central Station and Tramway Officials.**—When the Electricity Committee of the County Borough of Southampton recommended the appointment of Mr. H. S. Ellis, electrical engineer of South Shields, in the place of Mr. H. F. Street, who has resigned, the Mayor, as chairman of the committee, said the appointment was recommended though it created a precedent. The post had not been advertised for in the usual way. What happened was that the tramways manager suggested that Mr. Ellis, who was a long-standing friend of his, was the ideal man for Southampton. The Mayor interviewed Mr. Ellis, the committee interviewed him, and a deputation that visited South Shields reported favourably on him. Mr. Ellis was one of those first-class men who would not apply if the post were thrown open to competition. The committee's recommendation was strongly opposed in the Council, and an amendment that the post be advertised in the usual way was carried by 23 votes to 19.

Mr. Harry Heath, on leaving the Sheffield Corporation tramways department, to take up an appointment with a private firm at Sheffield, was presented by the staff with a silver tea kettle. Mr. A. R. Fearnley, the manager, made the presentation.

Exeter T.C. has referred back to the Electricity Committee for reconsideration a recommendation to increase the salary of the electrical engineer, Mr. H. D. Munro, to £768 per annum, without a suggested bonus.

Rochdale Corporation Tramways Committee has recommended that the salary of the general manager, Mr. George Webster, be increased from £500 to £600 per year.

Mr. J. M. Calder, chief assistant engineer of the Reading Corporation tramways, whose services had been lent to the Southampton T.C., has been presented on his return to Reading with an attaché despatch case.

Taunton T.C. has increased the salary of the electrical engineer, Mr. A. J. Howard, by £120 a year.

Major Barker, borough electrical engineer at Barnsley, hopes to return to duty by May 1st.

Epsom U.D.C. has informed Captain Gilling, electrical engineer, that they do not consider it necessary at present for him to take any active steps in connection with his return to civil life so far as the electricity department is concerned as the question of the position of the undertaking and procedure are under consideration.

The Dublin Corporation, on the motion of Alderman O'Connor, seconded by Alderman Byrne, adopted the recommendation of the Electricity Supply Committee for the appointment of Mr. L. J. Kettle to the position of chief city electrical engineer, in place of Mr. Mark Ruddle, resigned. Alderman McCarthy said Mr. Kettle was the right man for the post, but asked for further information in regard to salary. Mr. F. J. Allan, secretary of the committee, said that Mr. Kettle's income as deputy engineer was £600, plus 28s. 6d. war bonus, plus 12½ per cent. The total was £743. With the adoption of the report he would receive about £905. Alderman T. Kelly objected to the promise of an increased salary based on results in the course of a few months, and moved that the word "twelve" be substituted for "few." This was seconded by Mr. Mahon, and agreed to by 32 votes to 8.

**General.**—Mr. A. F. W. Richards, who has for 13 years been on the staff of Messrs. W. T. Glover & Co., Ltd., and previously had many years' experience in electricity supply, is about to join Mr. A. Murray Coombs as partner in the practice of advisory engineer, which the latter has carried on for some ten years at 31, Charing Cross, London. Mr. Coombs, an Old Faradian, had at the outbreak of war a large circle of clients in connection with electrical undertakings abroad, in addition to his consulting practice at home; during the war he served in the R.A.F., and has recently been demobilised. His experience, together with the wide knowledge of cable problems which Mr. Richards has acquired, forms a happy combination, and the new firm has our best wishes. Mr. Richards remains at his present address until June 30th.

A financial daily states that Sir John Aspinall, ex-general manager of the Lancashire and Yorkshire Railway, has joined the board of the English Electric Co., Ltd.

Mr. Henry William Allen, F.C.I.S., director (formerly secretary), and Mr. William Walter Bradfield, C.B.E., director (formerly manager), have been appointed joint general managers of Marconi's Wireless Telegraph Co., Ltd., and the Marconi International Marine Communication Co., Ltd. Mr. H. W. Corby, F.C.I.S. (formerly assistant secretary), has been appointed secretary of the companies.

Mr. Murray D. Scott has resigned his position as electrical manager to Messrs. Medway's Safety Lift Co., of Deptford, S.E., and has accepted the managing directorship of Messrs. Marryat & Scott, Ltd., 28, Hatton Garden, E.C., a company which has been formed to conduct the lift, crane, and hoist business of Messrs. Marryat & Place and Joseph Richmond & Co.

The King has granted permission to Mr. A. E. L. CHORLTON, C.B.E., to wear the Cross of Officer (Order of the Crown of Italy), which has been conferred upon him in recognition of his valuable services.

We understand that Mr. ROBERT NELSON, H.M. Electrical Inspector of Mines at the Home Office, has, in order to take up another appointment, tendered his resignation, and that it has been accepted.

At the Dock Offices, Grimsby, on 11th inst., Mr. J. L. H. COOPER, B.A., A.M.I.E.E., A.M.I.Mech.E., was presented with a wrist watch by his late colleagues on the Great Central Railway on resigning his position as assistant electrical engineer to the company in the Immingham and Grimsby district, to commence practising as consulting electrical engineer in Grimsby. The presentation was made by Mr. Hellyer, the assistant portmaster, who, after referring to the cordial relations existing between Mr. Cooper and the heads of the various railway departments at Immingham and Grimsby during the six years of his connection with the company, and expressing the sense of loss felt by all upon his resignation, conveyed to him the heartiest wishes of his late colleagues for his success in the new career upon which he had entered. In his reply, Mr. Cooper said that in the new branch of his profession which he was taking up he hoped it would still be his privilege to meet from time to time the local officers of the Great Central Co.

**Obituary.**—MR. W. J. LINEHAM.—We regret to record the death, which occurred at Brighton on April 17th, at the age of 60 years, of Mr. Wilfrid James Lineham, B.Sc., M.I.M.E., M.I.C.E., M.I.E.E., &c. He was the author of the well-known "Text-book of Mechanical Engineering," and editor of the "D.U." technical series of publications.

**Will.**—The late Mr. FREDERICK WARD, London manager of the Commercial Cable Co., left £20,438.

## NEW COMPANIES REGISTERED.

**United Electrical Works, Ltd.** (154,152).—Private company. Registered April 5th. Capital £2,000 in £1 shares. Electricians, mechanical and general engineers. Directors: J. G. Shaw and C. R. Shaw, both of Crypto Electrical Co., Ltd., Acton Lane, N.W. (10), electrical engineers; J. C. F. Smith, 30, Eastcombe Avenue, Westcombe Park, S.E., electrical engineer; and C. R. Bates, 27, Martins Lane, E.C. (4), electrical engineer. Office: 150, Bermondsey Street, Bermondsey.

**Ferro-Arc Welding Co., Ltd.** (154,108).—Private company. Registered April 4th. Capital, £10,050 in 10,000 preference shares of £1 each and 1,000 ordinary shares of 1s. each. Manufacturers and suppliers of electrodes, fluxes, and apparatus for use in electric welding or other processes, metal workers, and founders, wire drawers, dealers in precious metals, makers of electrical and scientific apparatus, &c. The subscribers (each with one share) are: L. J. Yeoman, 20 Copthall Avenue, E.C.2; A. C. Hyde, Perivale Lodge, Perivale. First directors are to be appointed by the subscribers. Solicitor: C. C. Tarelli, 62, London Wall, E.C.

**Barnes & Morris, Ltd.** (154,137).—Private company. Registered April 5th. Capital £30,000 in £1 shares. To acquire the business of scientific instrument makers formerly carried on by F. Barnes and H. R. Morris at 182-3, Temple Chambers, Temple Avenue, and 172, Pentonville Road, N. Directors: Major F. Barnes, 7, Brixton Hill, S.W.2; H. R. Morris, 66, Fairholme Road, Baron's Court, W. Office: Audrey House, Ely Place, Holborn, E.C.

**Fluxio Welding Co., Ltd.** (154,199).—Private company. Registered April 8th. Capital, £5,000 in £1 shares, to carry out, on the company's own account, or for customers, oxy-acetylene, electrical, or other welding and re-welding, also work in connection with railway, motor and other vehicles, shipping, aircraft, &c. First directors: T. A. Cotton, 5, Rawcliffe Street, South Shore, Blackpool; J. P. Schofield, 15, Holmecliff Road, Blackpool; Dr. H. E. Cockcroft, 15, Holmecliff Road, Blackpool. Registered office: 5, Rawcliffe Street, South Shore, Blackpool.

**Premier Electrical Engineering Co., Ltd.** (154,226).—Private company. Registered April 8th. Capital, £5,000 in £1 shares. To carry on business as indicated by title. Directors: J. Broadhurst, Woodside Villa, Mottram Road, Stalybridge, yarn agent; J. E. Hardy, 10, Stonecliffe, Stalybridge, coal merchant's manager. Registered office: 33, Market Street, Stalybridge.

**Insulation & Metal Filaments, Ltd.** (154,202).—Private company. Registered April 8th. Capital, £50,000 in £1 shares. To acquire certain patents relating to the construction of insulating sheets, with a hard face, and to metal fitments, &c. The subscribers (each with one share) are: F. Snelling, 89, Dovercourt Road, S.E.22, law clerk, and B. H. Gower, 136, Colney Hatch Lane, N.10, solicitor's managing clerk. The directors are to be appointed by the subscribers. Registered office: 6, Old Jewry, E.C.

**Charles Bingham & Co., Ltd.** (154,197).—Private company. Registered April 8th. Capital, £10,000 in £1 shares. Manufacturers of and dealers in electrochemical products and apparatus. The subscribers (each with one share) are: C. H. Bingham, junr., 2, Kingswood Road, Upper Norwood, S.E.19, engineer, and A. Somerville Young, 7, Upper Hornsey Rise, N.19, merchant. First directors: C. H. Bingham, junr., A. Somerville Young, and Evelyn A. Bingham. Registered office: 11, Queen Victoria Street, E.C.4.

**Marryat & Scott, Ltd.** (154,254).—Private company. Registered April 9th. Capital, £2,000 in £1 shares. To adopt an agreement with H. Marryat for the purchase of that part of the business carried on by him under the title of Marryat & Place, which comprises the manufacture and erection of electrical and other lifts, hoists, cranes, and similar machinery. Life directors: H. Marryat, 28, Hatton Garden, E.C., engineer; M. D. Scott, 49, Hamley Gardens, Ravenscourt Park, W., engineer. Solicitor: B. W. Arnold, 35, King Street, Covent Garden.

**Ashdown & Wright, Ltd.** (154,161).—Private company. Registered April 7th. Capital, £500 in £1 shares. Electrical and mechanical engineers, &c. Directors: H. C. Wright, "Forest Lodge," Mayfield Road, Moseley, Birmingham, engineer; H. E. Ashdown, 8, Osborne Road, Handsworth, Birmingham, engineer. Registered office. 137a, Gilford Street, Birmingham.

**Tok Manufacturing Co., Ltd.** (154,333).—Private company. Registered April 12th. Capital, £10,000 in £1 shares. Electrical, mechanical, constructional, and general engineers, &c. First directors:—E. E. Sharp, 109, West Side, Clapham Common, S.W.4, electrical engineer; H. H. Holmes, 14, Queen's Road, Leytonstone, E., electrical engineer. Registered office: 6, Earl Street, S.W.1.

**Hall & Town's Instrument Co., Ltd.** (154,238).—Private company. Registered April 9th. Capital, £5,000 in £1 shares. To acquire the business of scientific instrument makers and repairers carried on by H. T. Hall, W. B. Towns, and B. Wortman; also to carry on the business of makers and repairers of instruments, watches, clocks, and cinematograph machines, mechanical, motor, electrical, and illuminating engineers, &c. The subscribers (each with one share) are: B. Wortman, 42, Waterloo Street, Hammersmith, W., aircraft designer and constructor, member Royal Aeronautical Society of Great Britain, member of Society of Chemical Industry, &c.; H. T. Hall, 42, Waterloo Street, Hammersmith, W., patentee and manufacturer of scientific and kinematograph apparatus. First directors: H. T. Hall, W. B. Towns, and B. Wortman (manager).

**Walshaw Clock Co., Ltd.** (154,183).—Private company. Registered April 7th. Capital, £20,000 in 10,000 preference shares of £1 and 20,000 ordinary shares of 10s. each. Manufacturers of and dealers in electrically operated and other clocks, &c. The subscribers (each with one ordinary share) are: G. I. Bassett, 34, St. Paul's Road, Canonbury, N., clerk; C. J. Willcocks, 17, Ravensbourne Gardens, West Ealing, W., clerk. First directors: A. G. Wallace (permanent managing director) and Agnes B. Shaw. Solicitor: F. P. Wood, 7, Bucklersbury, E.C.

**Llanelly Electrical Engineering Co., Ltd.** (154,322).—Private company. Registered April 12th. Capital, £4,000 in £10 shares. To carry on the business as title. The subscribers (each with one share) are:—A. E. Atkins, 19, Coleshill Terrace, Llanelly, electrical engineer; J. T. Penybryn, Llanelly, brewer; J. P. Hughes, Rosslyn, Llanelly, builder. The first directors are to be appointed by the subscribers. Solicitor: M. R. Richards, Goring Road, Llanelly.

**Boulton Magnetos, Ltd.** (154,395).—Private company. Registered April 15th. Capital, £4,000 in £1 shares. To take over the business of magneto manufacturers carried on by A. H. & J. H. Boulton as A. H. Boulton & Sons, at Old Hall Street, Wolverhampton. The subscribers (each with one share) are:—P. Thomas, York Avenue, Wolverhampton, brassfounder; A. H. Boulton, 146, Waterloo Road, Wolverhampton, magneto manufacturer. First directors: A. H. Boulton, P. Thomas, and C. W. Parkes, Church Hall, Tettenhall. Solicitor: A. C. Skidmore, Imperial Chambers, Lichfield Street, Wolverhampton.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**James Russell & Sons, Ltd.**—Deposit on March 27th, 1919, of deeds of freehold, copyhold, and leasehold properties at and near Wednesbury, to secure all moneys due or to become due from company to Lloyd's Bank up to £50,000.

**Penrith Electric Supply Co., Ltd.**—Satisfaction in full on December 5th, 1918, of mortgage dated June 3rd, 1912, securing moneys owing to Parr's Bank.

**Harry W. Cox & Co., Ltd.**—Particulars of £5,000 debentures created February 13th, 1919, of which £4,000 were issued on March 27th, charged on the company's property, present and future, including uncalled capital.

**Duroglass, Ltd.**—Equitable mortgage on leasehold premises at Walthamstow, and the company's general assets, to secure all moneys payable by the company to the Minister of Munitions under a loan agreement.

**Lobito, Benguella & Catumbella Electric Light and Power Co., Ltd.**—Supplemental trust deed dated April 2nd, 1919, to secure £10,000 6 per cent. first mortgage debenture stock (1916), ranking *pari passu* with £10,000 issued under the original deed of June 6th, 1916. Property charged: As per original trust deed. Trustees: Lord Waleran and Lord Rotherham.

**Nuneaton Electrical Contracting Co., Ltd.**—Deposit on April 1st, 1919, of deeds of freehold premises at Nuneaton, to secure all moneys becoming due from company to Barclay's Bank.

**Power Specialty Co.** (1,711F).—Particulars filed April 12th, 1919. Capital, $270,000 in $100 shares. Registered in New York on February 8th, 1900, to manufacture and deal in machinery. Principal office: Manhattan, New York. British address: 315-317, Oxford Street, W., where J. N. D. Heenan (London manager) and R. Dunn (secretary) are authorised to accept service.

## CITY NOTES.

**Consolidated Electrical Co., Ltd.**

Mr. H. Allen stated at the annual meeting, on April 17th, that the company had more than held their own in the matter of income during the war. They had kept in hand portion of the profits as a safeguard against contingencies. The total depreciation of their assets was less than 10 per cent. of the pre-war value. Subject to political influences, he was confident that the current year would see a recovery in value of their investments which had been most depreciated. The altered value of money had put an entirely different aspect on the business of trust and investment companies of the orthodox order. Such companies used to issue a lot of 4 per cent. debenture stock or 5 per cent. preference stock, or both, and a comparatively small proportion of ordinary. The whole capital was then turned over in loans, investments, underwriting, and so forth, at an all-round rate of 6 per cent. or more, and the result was a very nice dividend on the ordinary shares. This was precisely what they themselves had had in contemplation. But a glance at the price list of trust investment securities would show how the war had altered all that. There was still no difficulty in getting the 6 per cent. business, but investment and finance companies would not find it easy now to issue debentures of their own at much less than 6 per cent., or preference shares at less than 7 per cent. This meant that an issue of ordinary shares in such companies as theirs was now out of the question, and it also meant that the policy of the board in regard to their pre-war scheme of rearrangement and enlargement must be reconsidered.

**W. T. Henley's Telegraph Works Co., Ltd.**

During 1918 a profit of £203,411 was made. £55,357 is deducted for directors' and auditors' fees, debenture interest, depreciation on buildings and machinery, and for postponed repairs. £112,042 was brought forward, making £206,096. There was deducted: £36,586 for income tax; £25,000 for reserve; £9,000 for preference dividend. Dividend on the ordinary shares 3s. per share, less tax, for the year, £60,000; put to staff pension fund, £7,500; carried forward, £122,009. Provision has been made in the accounts in respect of liability for excess profits duty to end of 1918. Provision has again been made for special depreciation on machinery due to the war, and for machinery which has been bought specially for war purposes which will be useless or of problematical value after the war, also for postponed repairs of machinery and plant which it has not been possible to carry out during the war. The company has been enabled to reinstate in their former positions all of its employés who have up to the present been demobilised and have applied for re-employment. The losses in the war number 112, and inquiries are being made to ascertain the position of dependents to enable the company to give assistance where it is desirable. The total staff and workmen with the Forces numbered 968, and there were 342 casualties. The transfer of the motor tire business to a new company has been completed, the profits of the business having been taken over by the new company as from August 1st, 1918, and only the previous seven months' profits are included in the present accounts. Annual meeting: April 25th (to-day).

**Amalgamated Wireless (Australasia), Ltd.**—For the last half of 1918 the net profit was £4,018, plus £224 brought forward. A dividend at the rate of 5 per cent. per annum absorbs £3,500, and £743 is carried forward. The reserves stand at £29,217. No revenue was received from wireless telegrams. The restrictions upon the transmission and receipt of public wireless telegrams to and from ships within the range of Australia and New Zealand were removed at the end of December, but there will be no immediate benefit to the company, owing to the continued disorganisation of shipping. The net profit for the corresponding half of 1917 was £3,596, and 1916, £4,540.

**Madras Electric Tramways (1904), Ltd.**—The gross profit for 1918 was £31,697. After debiting interest and London office expenses, making provision for the debenture stock sinking fund, and putting £10,000 to depreciation and renewal account, the balance is £14,444, plus £3,957 brought forward. Preference dividend, less tax, £6,000; ordinary dividend 8 per cent., free of tax, £4,580; to general reserve, £3,000; carried forward, subject to excess profits duty (if any), £4,820. The traffic receipts increased by 11.2 per cent. over 1917. The expenditure in Madras consequent upon higher rates of wages and further increases in the prices of materials was 20.1 per cent. greater than in 1917.

**Cuba Submarine Telegraph Co., Ltd.**—Total receipts for 1918, £82,185; expenses, £21,881; cable repairs, £5,574; income tax, £4,524; excess profits duty for 1916 and 1917, £14,927; balance, £35,279 plus £21,907 brought forward; £15,000 to general reserve and £2,500 to pension fund. Preference dividend, 10 per cent., less tax; 5 per cent. and a bonus of 4s. per share, free of tax, on the ordinary shares; £22,486 carried forward subject to taxation for excess profits duty. Several cables have been repaired at a cost of £5,574, and they are now in good working order.

**Melton Mowbray Electric Light Co., Ltd.**—Mr. W. J. New presiding at the annual meeting, said that the load connected had increased from 929 to 963 kw.; motors connected were 391 h.p. The profit was £1,591, against £1,956 for 1917. Out of the available balance of £832, £600 has been placed to reserve and £232 is carried forward. The speaker said that owing to their difficulties a minimum charge of 13s. 4d. per quarter to every consumer would be necessary.

**Bell Telephone Co.**—The report for the year ended December 31st last shows that the revenue increased by $1,048,383, while the operating expenses, taxes, depreciation, &c., increased by $1,517,338. During the year 18,944 new stations were installed, and 2,888 miles of wire were added to the long-distance system. The long-distance lines now operated total 85,308 miles, in addition to 6,615 miles of underground and submarine cables.—*Canadian Electrical News.*

**Victoria Falls & Transvaal Power Co.**—According to the *Financial Times* the net earnings, including those of the Rand Mines Power Supply Co., for the quarter ended December 31st amounted to £210,853 before providing for taxation in South Africa and the United Kingdom.

**Stock Exchange Notice.**—Application has been made to the committee to allow the following to be quoted in the Official List:—

White (J. G.) & Co., Ltd.—180,000 7 per cent. cumulative preference shares of £1 each, fully paid (Nos. 1 to 180,000), partly in lieu of the preference shares quoted.

**Fairbairn Lawson Combe Barbour, Ltd.**—Dividend of 5 per cent. on the ordinary shares for 1918, against nothing for 1917. Carried forward £19,920, after putting £21,647 to reserve.

**Edison Swan Electric Co., Ltd.: New Issue.**—The *Financial Times* stated yesterday that underwriting arrangements have been in progress this week in connection with an issue of 200,000 ordinary shares which are to be offered at par, in the first place to existing shareholders.

**Argentine Tramways & Power Co.**—After payment of interest and sinking fund on debenture stock, and providing £4,000 as reserve for renewals, accounts for year ending September 30th, 1918, show profit of £2,620, which increases debit balance to be carried forward to £3,399.—*Financier.*

**Marconi International Marine Communication Co., Ltd.**—The resolution increasing the capital to £1,500,000, as already announced here, was approved at the meeting on April 16th. The restrictions under which the company has suffered for 4½ years will be removed on May 1st.

**Tynemouth & District Electric Traction Co., Ltd.**—To reserve £1,000. Dividend on ordinary shares 8 per cent. Carried forward £1,940.

**The Fuller Issue.**—It is stated that the issue of Fuller's United Electric Works, Ltd., 8 per cent. participating preference shares was over-subscribed.

**Potteries Electric Traction Co., Ltd.**—Dividend of 5 per cent. for the year on the ordinary shares.

**Monte Video Telephone Co., Ltd.**—Interim dividend on the ordinary shares at the rate of 6 per cent. per annum, free of tax.

## STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets found a very fair accumulation of orders awaiting them after the Easter holidays. Industrials attracted most of the interest. The oil boomlet started again. There is some speculation in the Stock Exchange as to what effect the formal declaration of Peace may have upon prices, and the general opinion is that it will make little difference beyond a stiffening of values in gilt-edged stocks. There are men who look, however, for a further outburst of animation in the issues of commercial companies. Greatly-daring spirits talk of a possibility that home railway stocks may improve.

Central London ordinary and Underground incomes are better; the latter rose to 97, but lost a point, and the price is 1½ higher on balance. The buying is due, of course, to the interest being paid free of tax. Speculators are picking-up the company's income certificates, which stand at eighteenpence. A very "long shot," these. East Londons remain at 4¼.

Electricity supply shares have already begun to feel the annual dulness inevitable to this market upon the approach of summer. A few of the higher-priced shares have eased off slightly. City of London, Westminster, Metropolitan, Brompton, and County are amongst the ordinary shares showing small declines. There is little business doing in any, but the tendency is heavy.

Dealings began on Tuesday (to-day) in the 6 per cent. cumulative preference shares of £1 each in the Shropshire, Worcestershire & Staffordshire Electric Power Co. The shares are offered at 17s. 6d., free of stamp-duty into the buyer's name. Dividends are due on March 31st and September 30th. The yield comes to 6¾ per cent. on the money, and the shares carry no participating rights. Those to whom such an investment appeals will be interested in the last five years' figures, which are as follows:—

| Year. | Units sold. | Gross revenue. | Expenses including debenture and other interest. | Profit. | Dividends on ordinary. |
|---|---|---|---|---|---|
| 1914 | 14,474,140 | £56,708 | £42,325 | £14,383 | 3 % |
| 1915 | 20,797,771 | 75,936 | 56,852 | 19,084 | 3½% |
| 1916 | 44,614,872 | 159,725 | 132,964 | 26,761 | 4 % |
| 1917 | 55,678,354 | 217,964 | 184,328 | 33,636 | 5 % |
| 1918 | 62,259,766 | *291,000 | *249,420 | *41,600 | *5 % |

* Estimated.

The reserve fund at December 31st, 1917, was £67,000, and it is anticipated that this will be increased this year to at least £84,000. The dividend on the £50,000 7 per cent. preference and the £150,000 6 per cent. preference shares amounts together to £12,500, which, on the basis of the above profits, is amply covered.

The above figures are taken from particulars issued by a well-known firm in the Stock Exchange.

Henley's ordinary are a good market at 48s. 9d. on the report, which shows a dividend of 15 per cent. for the year, against 25 per cent. a year ago, before the capital was doubled. The increase, therefore, is equal to 5 per cent. on the old capital, and this in spite of the fact that the gross earnings at £203,400 are £35,000 down on the previous year. The net profit of £148,000 is £14,900 lower, but a very large balance was brought in from last time, and the carry-forward is again the substantial amount of £122,000. India-Rubber shares are ¼ down at 16¾. Telegraph Constructions change hands round about 24, at which there are buyers in the market. Increased dividend on the doubled capital is already anticipated. The price of British Insulated has hardened to 2 1/16, and buying comes from well-informed circles in the North. British Aluminiums at 33s. 3d. have not recovered the dividend deducted last account-day.

In Marconis there was a good deal of profit-taking before Easter, and the prices of the various shares gave way on the selling. Buyers picked up Marines, however, and consider-

ing the sharpness of the previous rise, the fall has been trifling. Cable stocks are all steady. Anglo "A" hardened to 22, and Eastern ordinary gained a point. West India and Panama have fallen back to 30s. Globes are unchanged. Cuba Submarines strengthened on the repetition of last year's dividend.

The foreign group is out of favour. Brazilian Tractions, however, hold their recent recovery. British Columbia Electrics are flat. Mexicans are disposed to ease off, although great things are hoped from the extra session of the Mexican Congress called for May 1st, while the death of a noted guerilla leader is reported. On the other hand, fresh fighting has broken out in some parts. Anglo-Argentine Tramways 5 per cent. debenture has risen to 68½, at which the yield is rather over 7½ per cent. on the money. The Hydro Electric Power and Metallurgical Co. (Melbourne) is taking steps for the issue of 115,000 10 per cent. cumulative participating preference shares.

London and Suburban Traction preference are an unusually active market about 7s. 6d.; apparently there is a tip out to buy the shares, because we hear of gossip about the ordinary getting a dividend. A very tall order, this, at any rate, so far as the immediate future is concerned, and the price of 3s. shows what the market thinks of the airy optimism. London United Tramways debenture was sold the other day at 39½. Business in British Electric Traction ordinary is recorded at prices round about 43, and in the preference on the basis of 76¼, while the 5 per cent. first debenture is 83½, and the 4½ per cent. second debenture 68.

Automatic Telephones have risen to 32s. American Telephone capital stock is 2½ up at 110, and the company's bonds have also improved. Iron and steel shares are better on balance. In the rubber market, business is tame, but prices show trifling recoveries.

## SHARE LIST OF ELECTRICAL COMPANIES.

| | Dividend 1917. | Dividend 1918. | Price April 23, 1919. | Rise or fall. | Yield p.c. |
|---|---|---|---|---|---|
| **Home Electricity Companies.** | | | | | |
| Brompton Ordinary | 10 | 8 | 6¾xd. | −¼ | £5 8 16 |
| Charing Cross Ordinary | 4 | 4 | 3½ | | 5 14 4 |
| do. do. 4½ Pref. | 4½ | 4½ | 3½ | −½ | 6 18 4 |
| Chelsea | 5 | 5 | 3¾xd. | | 4 1 1 |
| City of London | 8 | 8 | 11½ | | 6 16 2 |
| do. do. 6 per cent. Pref. | 6 | 6 | 10 | | 6 0 0 |
| County of London | 7 | 7 | 10¼ | −½ | 6 16 3 |
| do. do. 6 per cent. Pref. | 6 | 6 | 9½ | | 6 3 1 |
| Kensington Ordinary | 7 | 6 | 6½ | | 5 2 2 |
| London Electric | Nil | Nil | 1½ | | Nil |
| do. do. 6 per cent. Pref. | 5 | 6 | 3½ | | 7 14 10 |
| Metropolitan | 4 | 5 | 3½ | −½ | 8 0 0 |
| do. 4½ per cent. Pref. | 4½ | 4½ | 3½ | | 6 18 6 |
| St. James' and Pall Mall | 9 | 10 | 7½ | | 7 0 4 |
| South London | 5 | 5 | 3½ | −½ | 7 5 6 |
| South Metropolitan Pref. | 7 | 7 | 20/6 | | 6 16 7 |
| Westminster Ordinary | 9 | 8 | 6½ | −½ | 6 3 1 |
| **Telegraphs and Telephones.** | | | | | |
| Anglo-Am. T l. Pref. | 6 | 6 | 99½ | | 6 0 7 |
| do. Def. | 1½ | 33/6 | 22 | +½ | 7 10 0 |
| Chile Telephone | 8 | 8 | 7⅞ | | 5 8 6 |
| Cuba Sub. Ord. | 7 | 7 | 11½ | +½ | *6 7 4 |
| Eastern Extension | 8 | 8 | 16 | | *5 0 0 |
| Eastern Tel. Ord. | 8 | 8 | 162 | +1 | *4 18 6 |
| Globe Tel. and T. Ord. | 7 | 7 | 14½ | | *4 16 7 |
| do. do. Pref. | 6 | 6 | 10½ | | 5 14 3 |
| Great Northern Tel. | 22 | 22 | 81 | | 7 2 0 |
| Indo-European | 13 | 13 | 87½ | | 5 13 0 |
| Marconi | 20 | 20 | 4⅞ | −⅛ | 4 2 0 |
| Oriental Telephone Ord. | 10 | 15 | 2⅝ | | 6 2 0 |
| United R. Plate Tel. | 8 | 8 | 7¼ | | *5 1 7 |
| West India and Panama | 1/3 | 1/3 | 1½ | −½ | *4 3 4 |
| Western Telegraph | 8 | 8 | 16½ | | *4 15 10 |
| **Home Rails.** | | | | | |
| Central London Ord. Assented | 4 | 4 | 63½ | +1 | 6 6 0 |
| Metropolitan | 1 | 1½ | 26½ | | 4 14 7 |
| do. District | Nil | Nil | 23½ | | Nil |
| Underground Electric Ordinary | Nil | Nil | 8½ | | Nil |
| do. do. "A" | Nil | Nil | 9/8 | | Nil |
| do. do. Income | 4 | 5 | 90 | +1½ | *5 4 9 |
| **Foreign Trams, &c.** | | | | | |
| Adelaide Sup. 6 per cent. Pref. | 6 | 6 | 4⅜ | | 6 11 4 |
| Anglo-Arg. Trams. First Pref. | 5½ | Nil | 3½ | | |
| do. do. 2nd Pref. | — | — | 3½ | | |
| do. do. 5 Deb. | 5 | 5 | 68½ | | 7 8 5 |
| Brazil Tractions | — | — | 5⅝ | | |
| Bombay Electric Pref. | 6 | 6 | 109 | | 5 11 7 |
| British Columbia Elec. Ry. Pfcs. | 5 | 5 | 59 | −3 | 8 10 0 |
| do. do. Preferred | Nil | Nil | 40 | | Nil |
| do. do. Deferred | Nil | Nil | 37½ | −3½ | Nil |
| do. do. Deb. | 4½ | 4½ | 61 | | 6 19 4 |
| Mexico Trams 5 per cent. Bonds | Nil | Nil | 61 | | Nil |
| do. 6 per cent. Bonds | Nil | Nil | 62 | | Nil |
| Mexican Light Common | Nil | Nil | 37 | | Nil |
| do. Pref. | Nil | Nil | 51 | | Nil |
| do. 1st Bonds | Nil | Nil | 68 | | — |
| **Manufacturing Companies.** | | | | | |
| Babcock & Wilcox | 15 | 15 | 93 | | 4 0 0 |
| British Aluminium Ord. | 10 | 10 | 14¼xd | | 6 0 10 |
| British Insulated Ord. | 25 | 19½ | 2¾ | +⅛ | 6 1 1 |
| British Westinghouse Pref. | 7½ | 7½ | 9½ | | 6 3 0 |
| Callenders | 25 | 25 | 10 | | 6 5 0 |
| do. 6½ Pref. | 5 | 6½ | 5¾ | | 6 3 10 |
| Castner-Kellner | 35 | 20 | 8½ | | 6 9 1 |
| Edison-Swan, "A" | — | — | 1⅞ | | 7 5 6 |
| do. do. 5 per cent. Deb. | 4 | 5 | 75½ | | 6 12 3 |
| Electric Construction | 10 | 10 | 11 | | 8 0 0 |
| Gen. Elec. Pref. | 5 | 6½ | 10½ | | 6 6 4 |
| do. Ord. | 10 | 10 | 17½ | | *5 12 0 |
| Henley | 25 | 25 | 5⅞ | +⅛ | 5 2 6 |
| do. 4½ Pref. | 4½ | 4½ | 4 | | 5 12 6 |
| India-Rubber | 12 | 10 | 16⅝ | −⅛ | *6 0 4 |
| Siemens Ord. | — | 10 | 9⅛ | | *7 11 0 |
| Telegraph Con. | 20 | 20 | 24 | | 5 0 0 |

Dividends paid free of Income Tax.

## MARKET QUOTATIONS.

**It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.**

### Wednesday, April 23rd.

| CHEMICALS, &c. | | Latest Price. | Fortnight's Inc. or Dec. |
|---|---|---|---|
| a Acid, Oxalic | per lb. | 1/5 | .. |
| a Ammoniac Sal | per ton | £80 | .. |
| a Ammonia, Muriate (large crystal) | " | £78 | .. |
| a Bisulphide of Carbon | " | .. | .. |
| a Borax | " | £43 | .. |
| a Copper Sulphate | " | £42 | .. |
| a Potash, Chlorate | per lb. | 1/9 | .. |
| a " Perchlorate | " | 1/9 | .. |
| a Shellac | per cwt. | £11 | .. |
| a Sulphate of Magnesia | per ton | £15 | .. |
| a Sulphur, Sublimed Flowers | " | £31 | .. |
| a " Lump | " | £23 | .. |
| a Soda, Chlorate | per lb. | 11d. | .. |
| a " Crystals | per ton | 170/- | .. |
| a Sodium Bichromate, casks | per lb. | .. | .. |
| **METALS, &c.** | | | |
| c Brass (rolled metal 2' to 12' basis) | per lb. | 11½d. | .. |
| c " Tubes (solid drawn) | " | 1/2½ to 1/3½ | .. |
| c " Wire, basis | " | 1/- | .. |
| c Copper Tubes (solid drawn) | " | 1/4 | .. |
| g " Bars (best selected) | per ton | £114 | .. |
| g " Sheet | " | £114 | .. |
| g " Rod | " | £114 | .. |
| d " (Electrolytic) Bars | " | £81 | £3 dec. |
| d " " Sheets | " | £161 | .. |
| d " " Wire Rods | " | £91 | £3 dec. |
| d " " H.C. Wire | per lb. | 11 5/16d. | 1/16d. dec. |
| f Ebonite Rod | " | 2/- | .. |
| f " Sheet | " | 2/6 | .. |
| n German Silver Wire | " | 2/6 | .. |
| h Gutta-percha, fine | " | 11/- | .. |
| h India-rubber, Para fine | " | 2/4½ | 1d. dec. |
| i Iron Pig (Cleveland warrants) | per ton | Nom. | .. |
| l " Wire, galv. No. 8, P.O. qual. | " | £40 | .. |
| g Lead, English Pig | " | .. | .. |
| g Mercury | per bot. | Nom. | .. |
| e Mica (in original cases) small | per lb. | 9d. to 4/6 | .. |
| e " " medium | " | 5/- to 10/- | .. |
| e " " large | " | 12/6 to 25-/& up. | .. |
| d Silicium Bronze Wire | per lb. | 1/3½ | ½d. dec. |
| r Steel, Magnet, in bars | per ton | .. | .. |
| g Tin, Block (English) | " | £223 to £224 | £3 to £4 dec. |
| n " Wire, Nos. 1 to 18 | per lb. | 4/- | .. |

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

**The Technical Inspection Association.**—A new Association, called the Technical Inspection Association, has recently been formed, which should appeal very strongly to many technical men throughout the Empire who are in any way interested in inspection work. It is the outcome of the Ministry of Munitions Inspection Department, and has been formed for two main purposes:—(1) To maintain intercourse and promote mutual assistance among its members, and (2) to conserve and co-ordinate for the national use the experience brought together by the War, and generally to develop the progress and standardisation of inspection in the engineering, chemical, and allied industries.

Owing to the stoppage of war work, the services of large numbers of men, most of whom possess high technical qualifications, and who have spent several years on the inspection of Government contracts, are now available. A list of such members is held by the honorary secretary, who will be glad to supply particulars to any of our readers who may be interested.

It is intended in the near future to make arrangements for series of meetings, at which papers on subjects connected with inspection will be read and discussed.

Membership is not confined to officials of the Ministry of Munitions Inspection Department, but is open to officers of similar status in any other Government Department whose work is purely inspection or mainly connected with technical and scientific subjects in which inspection is concerned, also persons of standing in the engineering and allied professions who are interested in inspection matters. Mr. W. Haynes Smith is hon. secretary, and until permanent offices can be obtained the postal address of the Association will be the Hotel Metropole, Northumberland Avenue, London, S.W. 1.

**Business Training for Engineers.**—In the University courses for training engineers in the United States and Germany, a certain amount of business training is given, with the result that in those countries there are many more engineers directing and administering engineering concerns than is the case in Great Britain. At the suggestion of the Dean of the Faculty of Engineering of the University of Bristol (Dr. Wertheimer), the Senate has decided that in future the curriculum for the B.Sc. degree shall include attendance at a course dealing with book-keeping, methods of administering and organising works, elements of commercial law, depreciation, estimating, costing, and writing specifications.—*The Times.*

# "RULES" IMPOSED BY ELECTRIC SUPPLY AUTHORITIES.

By CHARLES A. BAKER, M.I.E.E.

(*Concluded from page* 451.)

The introduction into an agreement for the supply of electrical energy of a "rule" or "book of rules" to control the wiring of the consumer's premises is presumably due to a lack of confidence on the part of the managers of supply undertakings in the ability or willingness, on the part of wiring contractors, to do reliable work. I hold no brief to speak on behalf of either side, but I have always felt that the supply authorities should not endeavour to over-reach their statutory powers by hampering and interfering with the private enterprise of wiring contractors. Twenty to twenty-five years ago, when central stations were being equipped simultaneously in several towns and districts, the necessary wiring was taken up as a source of profit by local tradesmen, who bought cheap material, and put it up without sufficient regard to its life and durability; the supply managers, perhaps, desired to take steps to prevent this by issuing wiring "rules." The position at the present time is not the same, and if any serious difficulty were introduced by an incompetent firm, this could be dealt with by making the leakage test with a fairly high pressure, which would automatically closure such trouble.

Other rules concerning the wiring of consumers' premises may be briefly noticed:—

(*a*) "Temporary wiring not allowed." The dividing line between temporary and permanent work is sometimes a very thin one, and the supply authority has no jurisdiction to decide between the two.

(*b*) "The use of switch lampholders (unless sample is approved) is not allowed."

(*c*) "Samples of lead-covered or special cable must be approved."

The supply authorities have no right of approval or of expression of opinion in respect of the materials referred to in (*b*) and (*c*).

(*d*) "Dry joints not allowed." This appears to exclude the use of porcelain connectors in the cast-iron boxes of a draw-in conduit system.

(*e*) "Free access must be allowed to the premises . . . to examine, test, and inspect in any way deemed advisable the wiring, fittings, meters, and all other matters connected with the electric installation, and all reasonable and suitable facilities must be afforded by the consumers to enable this to be done." This principle has already been commented on; it is here quoted only because it more fully emphasises the right claimed by some supply authorities to intrude into all parts of consumers' premises. They have no such right of intrusion.

(*f*) The sectional areas of all conductors should be so proportioned that the maximum current will not exceed 1,000 amp. per sq. in. The fall of pressure at full load not to exceed 2 volts." The Institution of Electrical Engineers' carrying capacity is 4,000 amp. per sq. in. for wires carrying up to 20 amp.

(*g*) "All flexible cords to be insulated with vulcanised india-rubber only." Opinions differ on the wisdom of this practice; if the strands of the flexible are tinned they are apt to be unduly brittle, on the other hand, the presence of sulphur in the vulcanised insulation will tend to damage the copper if untinned, therefore pure rubber for flexibles is considered by many engineers the better practice.

(*h*) "In the event of the insulation resistance falling below the required standard the installation will be disconnected, with or without notice, according to the seriousness of the defect." This is a rule which in one form or another appears in many application forms; the Board of Trade Regulation No. 30 clearly defines under what conditions the supply authority may discontinue the supply after due notice has been given to the consumer; such notice must be endorsed to the effect that the consumer, if dissatisfied with the action of the supply authority, has the right of appeal to an Electrical Inspector.

Passing on to the value of the energy supplied, the following quotation will serve as an example: "Should the consumer dispute his account he may . . . have the meter officially tested by the London County Council, and . . . if the mean inaccuracy of the meter be found to be more than 5 per cent. the supply authority will pay the cost of testing; if 5 per cent. or less the consumer shall bear all the expenses of testing." This is an arbitrary assertion that appears in a few of the "rules"; it is difficult to account for the way that such a statement has ever found a place in the "rules" of any supply authority. Until the passing of the Electric Lighting Act, 1909, there was no definite determination of a "correct meter," and—except for a memorandum for guidance issued by the Board of Trade—it was left to the discrimination of individual Electrical Inspectors, appointed under the Provisional Orders, to fix the variations within which a meter could be passed as correct; a limit of variation of 2½ per cent. from absolute accuracy at any point of a meter's range from one-twentieth to full load was decided on by the Electrical Inspectors for the numerous "areas of supply" of the County of London. The second schedule of the Electric Lighting Act of 1909, which contains provisions to be applied instead of provisions previously enacted, states that "a meter shall be considered . . . capable of ascertaining the value of the supply within such limits of error as may . . . be allowed by the Board of Trade. . . ." Subsequent to the passing of the 1909 Act the London County Council drafted a proposal which was very carefully considered by the Board of Trade, and, after a conference, approved—in so far as the accuracy of meters is concerned—in the following form:—

Certification of Meters.

1. A meter will be certified if it is of some construction and pattern approved by the Board of Trade, and has been found by the inspector to be capable of ascertaining the value of the supply with continuous or single-phase current within the following limits of error:—

(*a*) Meters in which the maximum current for full load does not exceed 3 amp., the error at any point from one-tenth load to full load must not exceed 3½ per cent. plus or minus.

(*b*) Meters in which the maximum current for full load exceeds 3 amp., but does not exceed 50 amp., the error at any point from one-tenth load to full load must not exceed 2½ per cent. plus or minus.

(*c*) Meters in which the maximum current for full load exceeds 50 amp., the error at any point from one-twentieth load to one-tenth load must not exceed 2½ per cent. plus, and at any point from one-tenth load to full load must not exceed 2½ per cent. plus or minus;

And these limits of error for meters will now doubtless be used universally by the Board of Trade in pursuance of its powers under the 1909 Act. It will be observed that the limits of variation are graded according to the size of the meters, and it is therefore perfectly clear to any Electrical Inspector what is and what is not a correct meter, and he must make his examination on the basis of these figures without regard to any clause contained in the form of application which has been converted into an agreement. Moreover the "rule" above quoted sets out the conditions as to payment for the expenses of testing the meters; here again the supply authority has no voice at all in the matter. Section 57 of the Electric Lighting Clauses Act states ". . . that the Inspector shall also order by which of the parties the costs of and incidental to the proceedings before him shall be paid, and the decision of the Inspector shall be final and binding on all parties." This gives the Electrical Inspector some discretion, having regard to all the circumstances of each case brought before him, in dealing, for example, with meters which are irregular or not in proper condition for registering a supply, or are overloaded, &c.

The whole question of the supply of meters under

the Electric Lighting Acts is less clear than is desirable. There must be many thousands of meters in use by the public, to record the annual consumption, which, according to a recent return prepared for the Coal Controller, reached 4,674,000,000 units for the year ending March 31st, 1918, but exceedingly few of these meters have ever been officially tested for accuracy; in this respect the supply and purchase of electricity differs from the basis of supply and purchase of most commercial commodities which take place with weights and measures that are without exception in all civilised countries stamped as accurate with a view to protecting the public. In the supply of electricity, the controlling clause in the Provisional Order reads: " . . . the value of the supply shall, except as otherwise agreed between the consumer and the undertakers, be ascertained by means of an appropriate meter duly certified, &c. . . ." Attention is drawn to this because it is usually held that the " application-form-agreement " of the supply authorities does so entangle the consumer that he " otherwise agrees," and is no longer entitled to claim a certified meter, but until a large account for the supply of electricity has been the subject of legal proceedings, and this point definitely determined by a judicial decision, the majority of the consumers must trust to luck that their bills are reasonable, although a meter occasionally slips through the manufacturer's hands with a dial so figured that ten times the amount used is charged for. If no agreement is signed, a certified meter must undoubtedly be provided. A well-known Council in London does not sign the usual application form in connection with the frequent additional supplies which it purchases in various districts of London. The following is a common form of the notice which is served on supply authorities when occasion requires:—

Council Offices.

To the ..... (Supply Authority).

Under the provisions of the ..... Electric Lighting Order (date), ..... and the Electric Lighting Orders Confirmation (No. ) Act (date) .....

The Council hereby give you notice that they require you to give and continue to give on and after the ..... (date) ..... a supply of energy in respect of the premises, and of the maximum power specified below, and to provide and let for hire on such premises the appropriate electricity meters duly certified in accordance with the provisions of the said Orders and Confirming Act.

Situation of premises .....
Maximum load .....
Dated this ..... day of .....

(Signed) .....

*Clerk of the Council.*

The last few lines referring to " letting on hire the appropriate electricity meter " are comparatively new, but the Council in question has for many years insisted on all the electricity supplied to its premises being metered with certified instruments; from the point of view of public officials and auditors dealing with accounts in respect of electricity supplied, examination into the mathematical accuracy of such accounts becomes a farce when an uncertified meter has been used, and this is certainly common practice under the existing system of application forms and agreements. That existing uncertified electricity meters are usually kept in good working order and are so correct reflects the greatest credit upon the manufacturers of these instruments, and many of the supply authorities have well-equipped testing rooms in which great care is exercised in checking the condition and reliability of the meters installed on the consumers' premises, but the fact remains that the supply authorities are still the people who do the testing.

" The supply authority will fix the position of the meter and the point upon the consumer's premises at which the supply will be given." It is at once obvious that there are other interests to consider beyond those of the supply authority in determining the position of the service and the meter; in a building of any magnitude the economical centre of distribution is one for the decision of the man who designs the installation, and in new buildings, chases for conduits are frequently left in the walls as the work proceeds, which have been decided on prior to any negotiations with the supply authority. Officials are entitled to come on to the consumer's premises at all reasonable hours to inspect the meter or accessory apparatus, and it may be more convenient to admit them to one part of the premises than to another.

" Inaccuracies in the registration will be charged or allowed (as the case may be), but not previous to the quarter's account last rendered." Such wording as the foregoing is generally found amongst the " rules." In occasional examples where a meter with an incorrect ratio or a multiplying constant of " 10 " has escaped observation, or an ampere-hour meter is erroneously put on to a circuit of different voltage to that for which its calibration has been determined, the accounts should be adjusted for a longer period than that to which the consumer is asked to agree in this "rule."

" The supply authority shall not be held responsible for any damage, loss, or inconvenience arising from any interruption or discontinuance in the supply of electricity occasioned by the removal of faults from the mains of the supply authority by any accident that may arise or by any other cause whatever." By the last few words of this " rule " the supply authority relieves itself of every liability for penalties to which it is liable under the Provisional Order if the supply fails, viz., " 40s. for each day on which the default occurs." Fortunately there is seldom cause to levy a penalty of this description, but it is not an asset that any party to an agreement would willingly and knowingly forgo, nor is it creditable to the supply undertakings thus to evade a responsibility put upon them by Parliament as one of the conditions upon which a Provisional Order is granted to them; it is one of the points that the consumer, who is important enough to employ a solicitor to advise him on the agreement, is apprised of and deletes; the smaller consumer trusting the big undertaking is deceived. This " rule " is not universally imposed, but looking through the London application forms, it is found in a sufficient number of them to justify drawing attention to it.

Quite a large number of the application forms—whilst binding the consumer to certain terms outside the Act—reserve to the supply authorities the benefits of the Act and of the agreement, as the following quoted " rule " will indicate:—

" Nothing in this agreement is to abridge or prejudice the rights and remedies of the supply authority under their Provisional Orders and Acts, and the Acts referred to therein or incorporated therewith."

If such equitable terms were made applicable to the consumer also there would be no agreement to abridge or prejudice, each side relying on the rights and remedies of the Provisional Orders, &c., and there would be nothing further to criticise; the ideal application form would, in the author's opinion, be arrived at, corresponding in brevity with the notice printed on the very numerous contracts entered into between the railway companies and their passengers every time a ticket is sold and purchased, and resembling the form already referred to which is used by one of the London Councils. What the exact terms of the Provisional Order and Confirming Act are, together with the correlation of other Acts and their interpretation, are matters for lawyers; even if the greater part of the clauses of the Provisional Order were reprinted on each application form the legal significance of the clauses could not be appreciated by the general consumer, therefore the omission of all quotations from the Electric Lighting Acts is advocated, and certainly

all forms of illegitimate "rules." Suitable application forms, in blank, should be kept by every wiring contractor on which his own firm's name and address might be stated, and to suggest that every wiring contractor should be entitled to a commission on every such form sent in to the supply authority, for each new consumer that has been obtained for the mains, would only be applying to electricity undertakings a system that is approved in very many other undertakings where agents are on the look-out for the central authority, to the benefit of both. As an alternative to this proposal of the briefest possible application form, which it is recognised means practically abandoning a system which for a number of years has found favour with many of the supply authorities, the author suggests that the Institution of Electrical Engineers should draft a standard application form, which would be suitable for general purposes and fair both to the supply authority and to the consumer; the public would appreciate such a document, which would effect much economy of time to all those who, in ever increasing numbers, must in years to come be responsible for signing their names to an application form which could be read through and grasped in a very few minutes, whilst the supply managers would be strengthened in dealing with their boards or committees in removing the existing sets of "rules," which are open to so much adverse criticism.

## SURFACE CONDENSING PLANT FOR LARGE POWER STATIONS.

At Birmingham, on March 26th, Mr. R. J. Kaula's paper (an abstract of which appeared in our last issue) was read and discussed before the South-Midland Centre of the Institution of Electrical Engineers.

Mr. R. A. Chattock, opening the discussion, said the paper did not, in his opinion, emphasise sufficiently the extreme importance of reliability in connection with condensing auxiliaries. Whilst he agreed that it was perhaps safe to use one circulating pump if sufficient spares were carried, he certainly thought that the driving of this pump should be in duplicate, as there was much more chance of breakdown on this portion of the apparatus. It was of vital necessity to provide against breakdown as far as possible. He was of opinion that the best arrangement was to install two circulating pumps, each of about 60 per cent. of the full-load capacity, and to drive one of them by a steam turbine and the other by an electric motor. Both pumps would be run, and should one break down, the other could carry the load with a reduction of only 1 in. to 1½ in. in the vacuum. The amount of steam used by the small turbine was not excessive, and the whole of the latent heat in it could be recovered by heating the condensate before it was returned to the boilers, instead of being wasted as was the case with a turbine of full capacity. As regards air, water-extracting, and lift pumps, these being small and inexpensive, there was no objection to putting them in duplicate and each of full capacity. Also as their stoppage was not of serious importance for a few minutes, it was safe to risk driving them entirely by electric motors. He did not agree that A.C. motors should be used for this purpose; the speed variation that was obtainable with D.C. motors made the latter method preferable; also with A.C. machines there was another link in the chain to go wrong, and the possibility of a temporary stoppage was increased should anything fail on the main A.C. supply. He rather favoured the steam-ejector type of air pump, in which there were no running parts to get out of order, and it had been demonstrated that very high vacua could be carried with a proper arrangement, whilst the whole of the latent heat in the steam used could be recovered. Another advantage was that it was a simple matter to de-aerate the condensate and the make-up feed water by means of these ejectors, thus eliminating oxidisation in the feed pipes and boilers. Mr. Kaula's description of straining circulating water was interesting, but he thought that with most river waters it would be found that the strainers would very soon become choked up. With Thames water this took place in about 1 to 1½ hours, and it was obviously impossible to keep reversing the flow of such large pipes as frequently as that. He emphasised what a very valuable asset a big industrial city had in the filtered sewage effluent that was running to waste. At Birmingham it had been demonstrated that this effluent was even more suitable for surface condensing than ordinary water. He maintained that all large industrial centres should look very closely into the possibilities of utilising their filtered sewage effluent.

Mr. G. H. J. Parkinson said he had made a careful test on a Green's economiser to test the effect of increasing the velocity of water through the tubes. The economiser was divided into three sections all in parallel. He reconnected the economiser with the three sections in series, but although this increased the velocity in the ratio of 3:1, the final temperature was the same as with the sections in parallel. The experiment was carried on long enough to get a fair average reading, although it was impossible to guarantee exactly the same conditions; unless the increased efficiency due to high velocity was very marked the extra cost of pumping against the increased friction was a serious consideration. He had found the cleaning of scale from condenser tubes with hydrochloric acid a very dangerous proceeding if the tubes were cleaned *in situ*. The acid had a serious effect on the cast-iron water bonnets; after cleaning a condenser two or three times in this way the tool marks on one of the hand-hole doors, which had been machined on the inside, were still clearly visible, but on scraping the surface with a knife he found he could cut it away for a depth of nearly ¼ in.; the iron had disintegrated, leaving a mixture of graphite and finely divided iron.

Mr. F. Forrest, referring to the author's fig. 1, said that if w lb. of water were to be cooled from $T^2$ to $T^1$, then $w \times (T^2 - T^1)$ heat units must be given up. Assuming that cooling towers were being used, the whole of these heat units would be expended partly in raising the temperature of the air passing up through the towers, and partly in evaporation, and if they knew the relative humidity of the external atmosphere and of the heated air were it left the top of the towers, they could calculate very closely the quantity of water evaporated under given conditions. With the average conditions prevailing at Birmingham, this evaporation amounted to approximately one gallon of water for every unit generated, and this figure gave the quantity of make-up water which was required for the cooling-tower ponds. The curve showing lb. of free air per 1,000 lb. of steam was not one that was likely to prove acceptable to purchasers. The usual figure of 0.8 lb. of air per 1,000 lb. of steam rejected to condenser might be used as a reasonable basis for turbine plant working under average modern conditions, and if some such figure as this were generally agreed to, then the condenser and the air pump could be tested together with calibrated air nozzles attached to the condenser casing to demonstrate that the air-pump capacity was easily capable of dealing with the normal quantities of air likely to be present.

Mr. P. R. Boulton said that Mr. Kaula stated that the heat transmission coefficient varied distinctly with the cooling water velocity; he did not, however, discuss the effect of the steam velocity on this figure. In testing condensers, the method of taking temperatures by inserting thermometer pockets at one point of the inlet and outlet pipes was not sufficiently accurate since the water left the condenser in layers of different temperatures. To obtain the average, either a number of pockets should be inserted, or a tube made of high-conductivity metal should pass diametrically through the centre of the outlet pipe. One end of this tube should be sealed, to prevent air circulation, and the bulb of a thermometer having a very long stem should make contact with the inside of this tube by means of metal foil; in this way the temperature could be taken at different points. He did not think Mr. Kaula had sufficiently emphasised the importance of efficient air extraction. With regard to the water velocities, the commercial economy of modern plant would be improved by adopting a lower velocity, with consequent reduction in pumping charges, and installing an increased condenser surface, in order to obtain the same vacuum. An effect, which Mr. Kaula had not mentioned, and which would operate in favour of the adoption of a lower minimum difference, was that of the higher rate of heat transmission per degree difference at higher water temperatures. With regard to the relative advantages of steam and electric driving for auxiliaries, he considered the argument of the advocates of steam driving, namely, that it was much better to ensure reliability in the operation of auxiliaries, was a very strong one. Usually, when an interruption of supply occurred, the engineer-in-charge had quite enough to do, without the additional anxiety as to what was happening to the condensing plant.

**Railway Catenary Suspensions.**—A number of new patents relating to catenary suspensions are referred to in *Elektrotechnik und Maschinenbau* of January 5th. An Austrian patent of the Siemens-Schuckert Works shows how the tension can be automatically adjusted according to variations of temperature. The same firm protects in German patents methods of suspending the overhead catenaries for two parallel tracks.

The Allgemeine Elektrizitäts Gesellschaft shows in German patents methods of suspending two catenaries over a track, when heavy current renders two wires desirable. These are hung in such a manner that the wires can be independently moved sideways. Other methods of hanging the wires are described in other German patents, which also refer to section insulators.

The Bergmann Elektrizitäts Werke describes a method of taking current from fixed overhead points by means of a wire stretched along the length of the train above the roof.

# THE EFFECT OF AIR AND WATER ON MATERIALS USED IN ENGINEERING WORK.

By H. E. YERBURY, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE author favours the electrolytic theory of corrosion, which is now almost universally accepted, and is the most convincing, since its effects can be demonstrated. The process is in full accord with modern thought based on the fact that all metals possess a solution pressure which may be termed its escaping tendency to pass into the dissolved state. The solution pressure varies with the solvent, may be positive or negative, and is calculable for every solution. Even in pure water, or under conditions where a film of water may condense upon them, metals have a tendency to pass into solution. Pure water is seldom encountered in ordinary engineering work, as water usually contains traces of salts—acids or bases—with consequently a still greater tendency for the metals to pass from the atomic condition into the ionic condition.

An electric current conducts electrolytically by the migration of ions. All those elements which produce negative ions act exclusively as oxidising agents. As metals can only produce positive ions, followed by the formation of negative ions (or the disappearance of positive ions by mutual attraction), the metals themselves are thereby oxidised.

The function of oxygen in the process of rusting and corrosion is to oxidise the layer of hydrogen on the surface of the metal, and also to precipitate the iron and so remove ferrous ions from the solution. A film of hydrogen gas offers a high resistance, the action being termed polarisation, and were it not removed it would arrest the further solution of the metal, and as the mass of metal and the solution are of opposite polarity the solvent action would cease were it not for other factors. The destruction of the hydrogen film in ordinary corrosion is accomplished by the oxygen of the atmosphere which is dissolved in the water or electrolyte, or it may be removed by water in motion.

It follows that any substance which dissolves or reacts with hydrogen accelerates corrosion. This is found in practice to be universally true.

By its lack of homogeneity in composition and structure the average steel surface in water as it occurs in nature presents all the conditions necessary for active electrochemical corrosion.

Wrought iron generally is more resistant to corrosion than steel. It contains from 0.06 to 0.15 per cent. of carbon. Steel containing pearlite is very readily attacked under the potential difference set up by that structural constituent. It provides cathodes to the anodes of the ferrite in solid solution. Non-homogeneity of a metal favours pitting and general corrosion, as it provides a large number of small anodes and cathodes, and therefore greater action than would be the case with one large electrode. It has been proved that corrosion of steel in either acidulated or salt water was greatest when it contained the maximum percentage of carbon.

Pure carbon steels contain larger grains than alloy steels, and as the ferrite (pure iron) is always attacked, it is assumed that the carbides (composed of carbon with a metal) act as negative electrodes or cathodes to the positive anode elements.

In addition to the chemical composition of steel affecting its rate of corrosion, thermal and mechanical treatment are factors which cannot be ignored. Ordinary commercial steels in structural work are subjected to stresses where bent and riveted, and anodic and cathodic conditions are set up. A properly annealed metal in contact with a cold-worked metal invites active galvanic action in the presence of moisture.

The comparatively large quantity of graphite in grey iron produces a good electrode to act in opposition to the ferrite which is near it; whereas in white iron nearly the whole of the carbon is in the combined state. It is unfortunate that there are foundry difficulties when white iron is used. It is also more crystalline and brittle and difficult to machine.

In the author's opinion, the time is fast approaching when engineers will specify the constituents of castings, including pipes, when they are to be used in special positions and under conditions where salt or acidulated water or other good electrolyte is present.

The natural resistance to corrosion by cast-iron pipes as compared with wrought-iron or steel pipes is due to the skin, or chill, on the external and internal surfaces which brings about a partial change to white iron.

Where pipes are buried, the nature of the soil should be studied, and their useful life may be extended many years if care is exercised. For instance, it is well known that where pipes are buried near or on ashes, and water is present, active corrosion and pitting is readily set up. Clayey character of soil leads to an increased retention of the electrolyte, and it is therefore advisable to lay pipes in a layer of sand or porous earth.

Lead pipes should be enclosed in wooden casing, and not exposed to the solvent action of lime, plaster, mortar, or cement, as a free alkali, especially when assisted by moisture, invariably attacks leads.

Some interesting cases of corrosion of cast-iron pipes and also lead sheathing of dry-core cable have been brought to the author's notice. In a recent instance a large portion of the lead had been destroyed, and pitting and general corrosion of the interior and exterior of the cast-iron pipe had also taken place. As this particular cable had been damaged in a similar manner near the same place some few years ago an analysis of the soil surrounding this pipe has recently been made. It contained 21.18 per cent. of water, the ash content was about 77 per cent., and the sample showed the presence of a strong ammonia compound of the following amount, 0.0252 per cent. as ammonia, or 0.0672 per cent. as ammonium carbonate. On heating there was an objectionable smell of urea, and undoubtedly urine had been percolating the soil at this place. When urine is exposed to the air fermentation sets in, and the urea is converted into ammonium carbonate. Some water had entered the interior of the pipe, and electrolytic action had taken place between the cast iron and lead, and the exterior of the cast-iron pipe had been attacked. Although a slight leakage current was indicated, the voltage was no higher than would be expected where self-corrosion is taking place. These pipes and cables had been in service 19 years. The general condition of the cast iron and lead was characteristic of slow electrolytic action, which could undoubtedly be produced by local action or self-corrosion in this strong electrolyte without any leakage current.

Another fault occurred on a 204-pair cable where the iron pipe was decomposed and perforated, the lead sheathing being badly pitted and parts eaten away, and the wet paper and copper wires exposed. This action was caused by a leaky steam pipe which crossed the telephone pipe at right angles, making the ground wet and hot, thus producing an electrolyte and vigorous electrochemical activity.

A case occurred at Sheffield where a 102-pair cable passed close to some steel furnaces, the outer wall of which bordered on the footpath. A fault developed on this cable, and it was found that the furnace heat had charred the paper to a carbonised state without in any way injuring the sheathing or pipe.

It has been noted by many observers that corrosion of steel is not accelerated by contact with other metals or alloys. For instance, steel rods or shafts sleeved with bronze do not set up serious electrolytic action even in salt water, and bronze and brass nuts can be easily screwed off steel bolts, whereas under similar corrosive conditions a steel nut could not be moved.

*Boilers.*—Internal pitting and corrosion in boilers and pipes, &c., are largely due to the presence of air in the feed water. The amount of air present will, of course, depend on the source of supply, and may be from 1.5 to 5 per cent. of the volume of the water, the chief gases dissolved being carbon dioxide, oxygen, and nitrogen. Carbon dioxide and oxygen expelled by boiling often set up a corrosive action in the tops of steam drums and near the water-line.

In the author's opinion the time is rapidly approaching when measures will be taken to eliminate as far as possible all air from boiler feed-water. It should be very thoroughly removed from condensers, preferably by dry air pumps, and the heat units from all auxiliary sources should be utilised so as to obtain the highest possible temperature of the feed water. Air dissolved in water can best be liberated by breaking the water up into as fine a spray as possible at a high temperature in a vacuum tank before pumping into the boilers. The most effective way of minimising the quantity of air in feed water appears to be in a closed system, whereby the de-aerated condensate and make-up water is pumped direct to the boiler feed-range. In this system the make-up water in a surge tank would, of course, be a component part of the closed system, and if the water were required to be measured this would be done by a Venturi tube.

Exterior corrosion of boiler plates and tubes is generally brought about by the sulphur in the coal forming sulphur dioxide, which, with the steam generated from the moisture in the coal, together with the water formed by the burning of hydrogen, produces an acidulated electrolyte. This, however, is inactive unless the temperature of the boiler is sufficiently low for moisture to be deposited. It may therefore be said that the action of pitting and corrosion is greater in a boiler which is warm than when the boiler is steaming at full capacity. Careful and systematic tests should be regularly made to ascertain if there are any leaky condensers, as many boiler troubles have been traced to that source. The simplest test is the electrical conductivity one, as the conductivity is proportional to the percentage amount of the substance dissolved in the water. Owing to the conductivity increasing with a rise in temperature, corrections for temperature should be made.

*Tanks, &c.*—Hot water feed-tanks—especially where exhaust steam is discharged and air liberated—are very susceptible to corrosion, and hard, close-grain cast iron is recommended for tanks in preference to steel plates. Steel stays are often attacked, but stays and bolts made of Low Moor iron are generally free from corrosion. The quality of bolts

and nuts used in places and under conditions where corrosion may be expected is a matter of primary importance, since many instances may be cited where steam-pipe joints have given way, and it has been found that the bolts have been severely corroded, the electrolyte being condensed steam from leaky jointing material. Rustless steel is recommended for steam relay and double-beat valve spindles, as freedom of motion is often retarded by the film of oxide which soon covers spindles made of ordinary steel.

Where expansion joints or bellows pieces for water pipes have been made of iron or steel riveted together and galvanised, a very short life has resulted. Copper is recommended for expansion pieces, as its solution pressure is comparatively low.

*Rotary Pumps.*—Much trouble and expense has been occasioned by the failure of rotary pumps, and in the author's experience impellers have had to be renewed after about 12 months' working.

The principal trouble has been caused by pitting, corrosion, and cavitation, with the result that the efficiency has been impaired, and impellers and shafts have often been ruined in from one to two years when working with river water, and also when dealing with condensate containing air from surface condensers, more especially where pumps are running at a high speed.

If the design of pump does not permit the breaking up of the water, and all ports and passages are cleanly swept, corrosion and pitting are minimised, if not entirely prevented. High-tensile steel shafts should be encased in a brass or bronze watertight sleeve to prevent corrosion in ordinary river circulating water, as high-tensile steel tends to corrode more quickly than mild steel.

Shafts made of steel containing 14 to 19.5 per cent. of chromium are almost entirely free from corrosion in acidulated or salt water, and as a tensile test of from 45 to 48 tons can be obtained with good elongation, the use of rustless steel will doubtless be increased in the near future.

The hub or boss of cast-iron pump impellers is often attacked by general corrosion and pitting, and in the author's experience this destructive action has been so great during 12 to 18 months that hubs have been eaten into and the shaft attacked to such an extent that it has been almost impossible to drive off the impeller due to the volume of rust.

The action on other pump parts has been such that nearly all the ferrite has passed into solution, and the remaining so-called iron could easily be cut with a knife.

For the minimising of corrosion, cast-iron should be low in silicon and phosphorus and high in combined carbon, which closes the grain and hardens the iron.

Suction pipes should contain no air pockets, and the pump-suction lift should be as little as possible to obviate air leakage. In this connection drowned pumps are often preferred, although inspection is naturally more difficult.

Special attention should also be given to the design and maintenance of glands, as, from the design of some pumps, air naturally enters whenever the glands are not tight, or through imperfect water-sealing. The capacity of pumps is thereby reduced, and there is also a greater tendency to corrosion. It has also been found that circulating water when broken up in cooling towers has absorbed sulphur dioxide, chlorine, and ammonia from the atmosphere, and other soluble and insoluble substances in rain water, all tending to intensify the rate of corrosion, which is accelerated when the water is very hot.

The inlet river water should be admitted where it thoroughly mixes with the cooling-tower discharge water, so as to neutralise any concentrated acidity or impurity which might be brought about by the continual circulation of cooling-tower water only.

High-tensile bronze is recommended for impellers and pump shafts where the water is of a particularly corrosive nature.

*Condenser Tubes.*—Considerable trouble has been occasioned on land and sea by corrosion and pitting of condenser tubes. Apart from the usual pitting which often takes place from the inside of tubes by the action of water, &c., the author has recently investigated somewhat unusual cases of corrosion and pitting which have only taken place on that part of the tube over which the packing or grummet is fitted and retained by the ferrule.

This particular form of corrosion is started and continued from the outside surface of the tube until it is perforated, whereas in the majority of cases all pitting has started from the inside, and is fairly general over the entire surface exposed to the circulating water. It was noted that exterior corrosion and pitting occurred only on the in-flow ends of the condensers, that is, where the water is first broken up on entering the tubes, and also where the direction is reversed at the other in-flow ends of the condensers.

On taking an analysis of the cotton-tape packing after nine years' service it was found to contain :—

| | | | |
|---|---|---|---|
| Carbonaceous matter | ... | ... | 86.85 per cent. |
| Ferric oxide | ... | ... | 11.2 per cent. |
| Zinc oxide | ... | ... | 1.13 per cent. |
| Copper oxide | ... | ... | 0.82 per cent. |

The tubes were of standard brass of the usual 70:30 mixture.

It will be observed from the analysis of the packing that the water must have been heavily laden with iron oxide, and it appears that some of the circulating water had penetrated down the sides of the screwed ferrules and underneath the packing, the latter acting as a filtering and retaining medium. It will also be seen that zinc and copper had passed into solution.

It is significant that on other condensers working under the same conditions no electrolytic action had taken place, the only difference being in the composition of the tubes, which were of Admiralty tube mixture, viz., 70:29:1.

The author believes that a more perfect amalgam or alloy is obtained if tin is present, and although tin will dissolve in water the action is much smaller than on zinc, lead, or copper.

Brass tubes tinned inside and outside are protected to a limited extent both mechanically and electrolytically; and have therefore a longer life.

In the case under review, wherever the packing allowed oxide of iron, air, and possibly slightly acidulated water to be retained, all elements were present for galvanic action to be set up. Care should therefore be given to the size of the hole in the tube plate and to the fit of the tube and ferrule, so that the packing may be kept as watertight as possible.

It has been demonstrated that where an extraneous current has been applied, as in the Cumberland process, thereby making all tubes cathodic, the trouble has been minimised, if not entirely prevented. A current density of about 0.1 ampere per sq. ft. of surface is recommended for this process.

*Turbo-Generators.*—The effect of moisture on electrical generators due to the application of wet-air filters has often caused trouble. It has been found that, partly owing to the fluctuating load on a generator, the temperature of the machine has varied so that when the machine is lightly loaded the temperature rise has been insufficient to dry the moist air from the filter, with the result that the insulation resistance has been reduced to a dangerous extent.

On the other hand, if the temperature is high, all moisture is quickly evaporated and undesirable salts are deposited on the windings, thus providing a path for leakage on extra-high-tension machines.

It appears that in order safely to withstand saturated air, generators should be impregnated under vacuum with an insulating varnish. By this process, with proper insulating materials, the general insulation resistance should be high enough to withstand satisfactorily the cumulative effect of a wet-air filter.

On extra-high-tension machines it is now deemed advisable to discard metal packing pieces, owing to their oxidising tendencies and conductivity, and to revert to wood or moulded insulating compounds.

*Economiser Pipes and Boxes.*—With water below 100 deg. F., corrosion is often set up on the outside of economiser tubes, whether of cast iron or steel, due to condensation of moisture from the passing gases. This moisture is an exceedingly good electrolyte, as it invariably contains sulphuric acid, derived originally from the sulphur in the coal forming sulphur dioxide during the process of combustion and combining with the vapour present. Unless the feed water is heated, at least one-sixth of the tubes are often corroded to about 18 in. from the bottom boxes, and the boxes also suffer badly. The obvious way to prevent external corrosion is to raise the temperature of the water by means of feed heaters or circulators fitted to the economisers, so that hot water is made to circulate from the lowest parts. With water at a temperature of 110 deg. F. and upwards, no trouble need be anticipated. Where internal corrosion is found, an analysis of the feed water is required, with suitable chemical treatment. Cast-iron economisers should be made of metal having the lowest possible percentage of free graphitic carbon.

*Turbine Blades.*—In the early days of turbine manufacture steel blades were found to be pitted and corroded badly, especially when a turbine was frequently stopped and started again after a lengthy period. It has also been found that where leakage of steam has taken place at a closed stop-valve, thereby allowing moisture to condense on the blading, electrolytic action is set up, resulting in blade erosion and loss in efficiency. Cases are on record where certain rows of blading have corroded where the steam temperature has dropped below dew point, and only at this stage in the length of a turbine has damage been done.

Corrosion of turbine blades has also been traced to carbon dioxide in the steam derived from unsuitable feed water, the remedy for such action being the elimination of the carbonates from the feed water by chemical treatment.

*Injury to Non-ferrous Metals, &c.*—The presence of vapour or water deposited on brass and other alloys often causes verdigris, which is the result of the metal passing into solution. The solution pressures vary greatly with the composition and state of the metal. Where it has been strained, say, in the process of bending, the corrosive effect is intensified. Sharp right angles should always be avoided and easy bends substituted.

Much damage has been done to extra-high-tension electrical machines and apparatus where a silent static discharge or sparking has taken place, nitrous oxide and ozone being formed, and in the presence of moisture corrosion has started, with serious results. Ozone is a very great oxidising agent and most metals are quickly attacked by it.

If an electrical discharge cannot be prevented, care should be exercised to see that moisture and condensation do not settle on these parts.

In the author's experience much trouble has resulted from vapour condensing on cold porcelain insulators enclosing

brass contacts, causing serious oxidation, high resistance, and eventually open circuits. All extra-high-tension switchgear and auxiliary switch and fuse contacts should be enclosed, if possible, in oil. The quality of the oil is of supreme importance, and it should be free from every trace of water and acid.

Zinc having high electropositive characteristics, and lead also being electropositive to copper and brass, the author thinks that as alloys of copper and tin only—in the proportion of 91 per cent. of copper and 9 per cent. of tin—are now made (Morrison bronze), and tests up to about 45.7 tons per square inch can be obtained with 22 per cent. elongation on rolled rods, zinc will be looked upon with disfavour in many cases.

The destruction of galvanised iron is brought about by the zinc being dissolved by moisture. This action is more easily accomplished on commercial zinc than on pure zinc. When an electrolyte such as rain water is present electrolysis is set up, the zinc destroyed, and the underlying metal attacked.

*Protection of Outside Structures.*—Speaking generally, paint should be totally inhibitive as well as protective, and should possess thorough insulating and moist-proof properties. The coating should have the same coefficient of expansion as the metal, so that it will not be affected by changes of temperature. It should also possess acid-resisting as well as alkali-resisting qualities.

Certain inaccessible parts of steel structures under special conditions should be painted with an elastic medium which at all times retains its elasticity.

Graphite is still largely used for coating steelwork, and is fairly satisfactory, especially when lead is added to the pigment to give it a better hold on the metal.

Linseed oil is the principal vehicle used in all paints, but different pigments produce different results. Linseed oil absorbs oxygen from the air, and thereby its volume is increased and also its weight, a substance known as linoxygen being formed, which on continued oxidation evolves carbon dioxide and water. This electrolyte furnishes a medium for electrolysis to be set up between the metal and the pigment, the former being the anode and the latter the cathode. Expansion caused by rust exposes the metal surfaces underneath, and in the presence of water vapour further corrosion takes place.

Special paints are now on the market which have been subjected to a curing process by heat treatment in the absence of air. All volatile substances are thereby eliminated, so that when the coating is applied it oxidises and does not evaporate, thus producing a film impervious to moisture, and the permeability of linoxyn is thereby reduced. All moisture, resin, sulphur, and any other element that would excite corrosion should be eliminated. Certain paints containing dryers, benzine, or neutral oils, have a tendency when dry to dissociate and break the bond between the pigment and the vehicle, and thereby become pervious to moisture. Good results depend on proper mixing before immediate application. Red-lead paint chemically combined so as to prevent the red lead from separating and settling to the bottom forms a good material, especially for shop coatings.

The colour of the pigment also affects the results, and dark colours are recommended for the protection of iron or steel.

It is most important that steel and iron surfaces should be thoroughly dry and cleaned from mill scale, rust, grease, and dirt, before applying the first coat of paint, which should consist of finely-ground pigment.

Multiple thin coats of paint are recommended in preference to thick single coats for general protective purposes.

The most onerous conditions for preservative compounds are where the metal is alternately wet and dry. Tar and various bitumastic paints and solutions are found to give good results, have low permeability to oxygen and water vapour, and will withstand fairly high temperatures.

In reinforced concrete the cement should be absolutely waterproof, and the steel will then remain in a passive condition, due largely to the alkaline compounds. If concrete is not waterproof, electrolytic action will be started, with the inevitable result that there will be stresses in the concrete due to the products of corrosion, and the bond will be destroyed between the reinforcing metal and the concrete.

With suitable concrete 1½ inches in thickness surrounding the reinforcements for ordinary atmospheric conditions, and 2 inches for salt-water conditions, no injury can take place.

**French Colonial Wireless Stations.**—An article in the *Revue Générale de l'Electricité* abstracted from the *Economiste Français*, states that outside of the Mother Country there are 35 French radio-telegraphic stations in service, 25 in course of construction and 20 others projected. These include installations in Algeria, Madagascar, the Congo, Timbuctoo, Indo-China and the other Colonies. The author holds that the still unexecuted project of encircling the globe by a chain of wireless posts in French territory, reaching from the South of France and Tunis to the Marquezas Islands, thence under the Pacific to Central America and Martinique, is quite feasible. The Eiffel Tower sometimes receives signals from Panama, San Francisco and Honolulu, and it makes itself heard in New Zealand.

## PLANNING A WORKS RESEARCH ORGANISATION.

At Bristol, on March 31st, Mr. A. P. M. Fleming, O.B.E., delivered his lecture (an abstract of which appeared in our issue of January 31st, 1919), which was followed by a discussion, before the Western Centre of the Institution of Electrical Engineers.

Mr. H. I. Rogers said that it was undoubtedly a fact that conditions had altered most materially since the conclusion of the war. That assuredly meant scientific organisation and research work, which, although carried out quietly in this country, must be very greatly extended if they were to play their part in foreign competition. Prior to the war it was possible to compete with Germany and America, but he did not think that was possible to-day, so high were wages and consequently materials. The coal inquiry might be taken in conjunction with the present paper. Now that shorter hours were in vogue it was essential that scientific management should be brought into play in the colliery, and it was to the engineer they must look for operation at reduced costs together with increased output. Industrially they had passed through a bloodless revolution, but he thought they need have no fear regarding the future.

Mr. W. A. Chamen expressed his appreciation of the paper and the information which the author had given. One talked of research in the first instance as making new discoveries and finding out principles or facts in science, but Mr. Fleming had shown that research covered a very great deal more than that, and it was necessary in more ordinary matters in saving actual waste. He was sure all, whether power engineers or manufacturers, must welcome all efforts to increase research for that reason alone.

Mr. A. Ellis said there was no industry so capable of development by research work as the electrical. They should keep their end up now that they had come satisfactorily through the war as competition was going to be very severe. It occurred to him that if they were going to compete successfully, that research work was worthy of Government assistance financially in order that all classes could have a sporting chance of taking part in this world's work. He did not think there was a lack of men who were capable of being technically trained. He was glad the author agreed that the sandwich system was satisfactory. An interesting feature was the provision of service ducts in buildings. If these had only been generally adopted, how many troubles experienced to-day would have been got rid of. Large ducts in the principal streets for gas, telephone, and traction mains—instead of having to take up streets. In Cardiff they had built a technical college, a portion of which it was intended to set aside for research work. Thousands of pounds had been spent in fitting it up, and the necessity of spending possibly thousands more in the creation of a fund from which highly competent men could be paid an adequate salary was equally necessary.

Mr. A. L. Stanton thought it unfortunate that the author felt it necessary to go out of this country in order to furnish planning details, as he (the speaker) held that needs must be governed by the demands of the particular works with which they might be associated. Conditions in America differed greatly, both materially and psychologically, from those which prevailed here, and it was deemed a matter of regret that no information regarding existing conditions in this country had been given and no reference made, to the valuable work carried out, for example, by the National Physical Laboratory, and Messrs. Hadfields, Ltd., respectively representative, he believed, of high grade, State-controlled, and privately-owned research work developments. A far wider meaning was attached to the word "research" than was usually associated with it. Referring, for example, to the enumerated functions of a research organisation, it was not easy to accept the idea, that such an organisation should be vested with the control of matters grouped under headings numbered: (3), (4), (5), (9), (10), and (11), and he thought such inclusion embraced elements entirely outside the scope of "research" as commonly interpreted. Works managers, engineers, production superintendents, view-room chiefs, and other similar executive officials, directly or indirectly responsible for production, could not be placed, as the author's grouping would seem to infer, subordinate to a research department, without impairing the efficiency of production operations. Education of the right kind was needed, and systems of technical training which neglected the commercial aspect of industries were faulty. If the true value of team work and co-operation between research and production departments was to be realised it could only come about by educational methods which demonstrated its utility, along lines free from departmental antagonisms, mistrust, and prejudice. The cost figures quoted by the author, for originating and running a research department were prohibitive, unless either associated with large industrial enterprises or combines, which permitted of an advantageous centralisation of facilities desired; or equipped as State-controlled research centres, situated in localities where their utility was justified.

Prof. D. Robertson said, in connection with the lack of trained men, that he did not think, unless they did something to attract the men, they would get quite as many as they

wanted. If they wanted the best brains they must make the prospects as good on the average as they were in any other profession. He did not think research workers would work 48 or 44 hours per week, because that particular type of worker had to do different work. About the universities, they would be only too glad if local manufacturers would tell them their problems. If they did not tell them they had to imagine the problems or invent problems for them, and discovered at the end that they were no problems at all. He thought as a general rule universities should co-operate with manufacturers.

Mr. A. C. Macwhirter said that co-operation in research was a vital matter. The lack of trained men, as Prof. Robertson had said, was due to the miserable remuneration offered for this class of work. Without giving financial inducements one could not expect to get highly trained men. British workers from the scientific point of view were second to none, but in the past the commercial element had not taken advantage of their inventions.

Mr. W. Nairn said that at Bristol they had a large number of comparatively small firms and very few large ones. The large ones, of course, could provide for themselves, but considering the size of the laboratory which had been outlined, the annual cost of maintenance was a figure quite beyond small firms, and, in fact, quite beyond a combination of firms. One of the principal objects of scientific research was the conservation of the nation's resources of raw materials, therefore it ought to be compulsory for small works to have their plant inspected and checked for efficiency once a year. If compulsory inspection were adopted, a very great saving would be effected, and would mean a great saving to the works at a small annual charge. It would also bring in a steady source of revenue to the laboratory. There was nothing very startling about compulsory inspection, steam raisers had been used to it for a considerable time.

Mr. A. Nichols Moore said that not much had been said on national laboratories or national research. The introduction of State-controlled laboratories would more materially benefit the smaller industries than if research works were privately owned. They would all be most optimistic if private firms were going to be patriotic when the war was over and disclose the results of their research. Private research would mean that the purchaser was not going to reap that benefit which he otherwise might look for. The control of industry was drifting into the hands of gigantic financial combinations, possibly to freeze out the smaller manufacturer, who was one of the great supports of the country. He would like to see the development of laboratories on a national scale, so that all could derive the benefit of research work. Competing firms pursuing the same object were wasting brains instead of pursuing the same problem in one State-controlled laboratory.

Mr. A. P. M. Fleming, in reply, agreed that the great need for research work in the electrical industry, especially when one considered the almost unlimited bounds, would have to have more attention if the industry was to be developed on the right lines. There were some twenty research laboratories in this country, but it was extremely difficult to give details of these. People were very conservative in this country. In the United States it was totally different, there was no secrecy whatever, and that was one of the things they had to learn. When they were all making shells they assisted each other by giving "tips," &c., and he believed that spirit would persist after the war. In time they would get the centralised laboratory; in the meantime, however, there was much they could do in the way of assisting laboratories which would tend to stimulate research in industrial works. With regard to the intelligence department, he felt there was a good deal to be done in the way of national indexing. It was a very difficult and troublesome problem to avoid overlapping, and they hoped to avoid some overlapping when research associations were able to deal with the work of their particular industries. At Bristol, where the industries were so varied, he suggested that each industry might subscribe to a research organisation for its own particular industry. Another way would be to make the fullest use of their technical institutions, and aid in that way their proper equipment. Quite a lot of work could be done there. Sir Robert Hadfield's laboratory gave him all the information possible. Messrs. Brown-Firth's laboratory in a general sense was not so modern, and the adapted buildings were not so useful for the purpose he had in mind. The National Physical Laboratory was not what one would expect if one were starting to lay out the laboratory to-day. Industrial research depended on little things; one required different organisations for different industries, and he thought there was room for several points of view. One should remove from the shops as far as possible investigational work, so as to utilise manufacturing departments for the purposes for which they were designed, and not subject them to hampering conditions of experimental work. He fully agreed that the teaching staffs of colleges should have had works experience.

**Cable Standardisation in Germany.**—New rules have been published by the German Standardising Committee relating to the construction and installation of electric cables. These are given in detail in *E.T.Z.* of January 23rd, but are not of a nature permitting short abstraction.

## THE WIRELESS COMPASS.

Through the stimulation of necessity, the wireless compass or direction-finder, an instrument whereby the bearing of a ship on a shore station may be ascertained with speed and accuracy, has overcome the dangers and difficulties of fog and storm to mariners approaching port. Its value has been proved by service, it having been in constant operation on naval shore stations during the war.

It is not generally known that wireless operators were constantly on watch at various naval shore stations in the vicinity of New York, nor that, during the war, operators timed the length of, as well as the interval between, dots and dashes whose characteristics aroused suspicion, and manipulated the wireless compass to obtain a direction on the sending station. This work proved to be of valuable assistance in locating enemy stations. An interesting article contributed to the *Scientific American* by Mr. J. Lachenbruch, wireless electrician, U.S.N.R.F., deals with this subject.

In construction, the wireless compass differs from the usual receiving set mainly in the type of antennæ used. In place of the stationary aerial is a rotating five-foot frame with a few turns of stranded copper-bronze wire wound about it. The frame (fig. 1) is mounted on a vertical steel shaft which projects downward through the roof of the building into the room where the operator is on watch. In many stations, a cupola is built about the frame to afford protection against the elements and conceal its presence. At the base of the shaft, and within easy reach of the operator, the wheel which controls the turning of the frame is attached. The compass dial, a circular aluminium band, with the 360 degrees of the compass engraved on its surface, is fastened to the shaft near the roof of the shack; but the indicator is placed in a permanent north and south direction. Two leads from the frame form the electrical path between the antenna and the receiving set.

In conjunction with the receiver, an oscillating audion and an amplifier are usually employed, thereby magnifying the

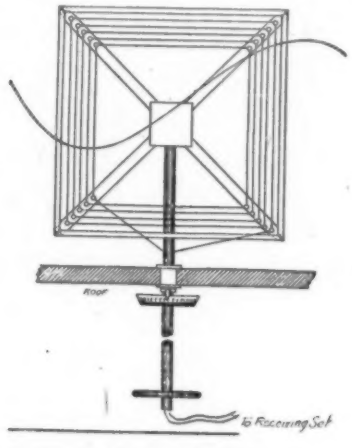



Fig. 1.—Wireless Compass Turned Parallel to an Oncoming Wave.

strength of incoming signals to about eight times their normal degree of audibility.

In the accompanying diagram, fig. 1, the plane of the wireless compass is shown parallel to the oncoming wave which strikes both sides of the wired frame at different phases and at different amplitudes. Two currents are induced in the antenna, one when the magnetic wave comes in contact with the nearer side of the aerial, the other when it reaches the farther side. These induced currents will be in the same direction, and consequently will tend to counteract each other. But, due to the differences in amplitude and in phase of the magnetic wave at the two points of contact, the induced currents will be of different strengths, and, although the one tends to obliterate the other, the difference in strength between them is conserved and heard in the telephones. However, if an incoming electromagnetic wave strikes the plane of the antenna perpendicularly, the currents induced in both sides of the compass will be equal in strength, of the same phase and amplitude, and will neutralise each other. No sound is then heard in the telephones. By means of the rotating antenna, the angle at which a wave acts on it can be controlled by the operator. Thus when the plane of the antenna is parallel to the direction of the oncoming wave, the sound heard in the 'phones will represent the maximum strength of the oncoming wave and, consequently, the position of the ship or shore station sending it will be disclosed. To be more accurate, two positions are usually made known, 180 deg. apart.

To obtain the best results in guiding vessels into the port of New York, five wireless-compass stations have been established at points on the coast. Each station is connected

by a land-line telegraph instrument with a central controlling wireless station. When a ship approaches the coast line, the operator aboard calls New York and asks for his bearing. The ship does not get into direct communication with the various compass stations, as they are equipped only with receiving sets. The central controlling station, in answering the ship's call, transmits a signal to the ship to send its call letters for 30 seconds, and at the same time notifies the various compass stations, by means of a three-letter signal sent simultaneously, to obtain a bearing on the ship sending her call letters.

The control station, when all compass stations have been heard from, transmits by wireless the bearing, in degrees, to the ship on different shore stations.

The accuracy of the bearing reported by each compass station is determined at the control station by consulting a map of the coast spread out on a table, and covered with glass. Holes are punctured through the glass at the centre of large circles drawn about the various compass stations as centres. The circumferences of the circles are divided into degrees. Threads are then led through the holes and laid out on the map. When a compass station sends a bearing to the control station, the operator there draws out a thread to mark the line of direction between the ship and the compass station. As the other bearings are reported, similar marks are laid down; and the point where all the threads intersect is the exact position of the vessel desiring to know its position.

## NEW PATENTS APPLIED FOR, 1918.

### (NOT YET PUBLISHED.)

**Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.**

8,670. "Accumulators for electric pocket lamps, &c." W. Robinson. April 7th.

8,688. "Generation of electricity." H. A. Farwig. April 7th.

8,694. "Electrically-controlled typewriters, &c." J. Greenwood. April 7th.

8,733. "Means for preventing sparking in appliances for making and breaking electric circuits." H. H. Hill. April 7th.

8,751. "Telephone systems." L. C. Bygrave, T. M. Inman, and Relay Automatic Telephone Co. April 7th.

8,759. "Winding of induction coils." F. Weatherill. April 7th.

8,783. "Make-and-break devices for magnetos, &c. E. Harrison. April 7th.

8,794. "Magneto couplings." T. R. Heyworth. April 7th.

8,795. "Electric furnaces." R. Steiger. April 7th. (Switzerland, April 8th, 1918.)

8,798. "Electrical device for heating liquids." W. B. Smits. April 7th. (Holland, April 5th 1918.)

8,823. "Combined pulley-wheel and extension for trolley pole of tramcars." J. M. Hodges. April 8th.

8,827. "Electric vehicles." W. Rogers. April 8th.

8,837. "Starting-switches for electric motors." J. S. Macintosh. April 8th.

8,852/3. "Lamp-holders and shade fittings for incandescent electric lamps." G. F. Joseph and A. A. Sines. April 8th.

8,855. "Controllers for electric motors." T. B. Lewis. April 8th.

8,863. "Rheostats." F. C. Curtis. April 8th.

8,864. "Electrical fittings." D. Anderson. April 8th.

8,877. "Electric signalling-apparatus for cars on electric, &c., railways." C. Kunzli and H. Schaub. April 8th. (Switzerland, April 23rd, 1918.)

8,880. "Apparatus for signalling and interlocking on railways, &c." G. B. Fielding. April 8th.

8,894. "Dynamo regulating systems." Electric & Ordnance Accessories Co. and J. Etchells. April 8th.

8,901. "Regulators for electric generators." British Thomson-Houston Co. (General Electric Co.). April 8th.

8,909. "Radio-telegraphic transmission systems." W. J. Mellersh-Jackson (A. Taylor). April 8th.

8,911. "Electric relays." Electric & Ordnance Accessories Co. and J. Etchells. April 8th.

8,914. "Electric selective switching apparatus." E. R. Baldock and International Electric Co. April 8th.

8,921. "Electric regulating systems." Electric & Ordnance Accessories Co. and J. Etchells. April 8th.

8,924. "Electric switches." C. A. Damey and R. K. Damey. April 8th.

8,927. "Collector for electrical machines." E. Bolton. April 9th.

8,928. "Self-electrical generator." G. E. Metcalfe. April 9th.

8,943. "Motor-cycle, &c., electric lighting sets." F. E. Cutler, Efandem Co. and W. Owen. April 9th.

8,944. "Dynamo-electric generators and electric motors." F. E. Cutler, Efandem Co., and W. Owen. April 9th.

8,969. "Papers for use as dielectric for electrical condensers, &c." F. Haigh. April 9th.

8,989. "Dynamos." M.-L. Magneto Syndicate and E. A. Watson. April 9th.

9,013. "Telephone and telegraph cables." Johnson & Phillips and G. C. Pearson. April 9th.

9,053. "Electric arc lamps." F. Proctor. April 9th.

9,054. "Directive aerials for emission of electric waves in definite planes." P. P. Eckersley. April 10th.

9,055. "Electro-magnetic wave-transmission systems." P. P. Eckersley. April 10th.

9,074. "Electrically propelled vehicles." J. Scott. April 10th.

9,095. "Systems for supplying electric power for lighting from low-frequency power circuits." J. R. Beard and Electrical Improvements, Ltd. April 10th.

9,096. "Visual and audible electric indicators." J. G. Rose. April 10th.

9,157. "Miners' safety, &c., electric lamps." G. Oldham and J. Oldham. April 10th.

9,168. "Wireless receiving and transmitting apparatus." J. Erskine-Murray and J. Robinson. April 10th.

9,175. "Storage batteries." J. L. Lorsch. April 10th.

9,178. "Apparatus for electrically igniting miners' safety lamps." V. E. Joyce and Park Royal Engineering Works. April 10th.

9,178. "Electric motors." G. Fryer & Portable Electric Motors, Ltd. April 10th.

9,179. "Commutators for dynamo-electric machines." G. Fryer and Portable Electric Motors, Ltd. April 10th.

9,186. "Apparatus for forming electric battery elements, &c." H. Wade (National Carbon Co.). April 10th.

9,187. "Apparatus for producing continuous electrically conducting liquid jet." J. F. G. P. Hartmann. April 10th. (Denmark, May 11th, 1918.)

9,188. "Apparatus for closing or interrupting electrical connection between two conductors." J. F. G. P. Hartmann. April 10th. (Denmark, May 16th, 1918.)

9,189. "Rectifiers for alternating electric currents. J. F. G. P. Hartmann. April 10th. (Denmark, November 14th, 1918.)

9,205. "Electric fuses." H. J. Abbott. April 11th.

9,206. "Brush-holders for dynamo-electric machines, &c." Electric Construction Co. and P. J. Stirrup. April 11th.

9,211. "Sparking-plugs for internal-combustion engines." F. W. Baker. April 11th.

9,235. "Electrical ignition systems of internal-combustion engines." A. Edwards. April 11th.

9,276. "Electric batteries." J. H. Goodman. April 11th.

## PUBLISHED SPECIFICATIONS.

**The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.**

### 1915.

16,008. Detection and transmission of earth vibrations. Mellersh-Jackson (Submarine Signal Co., U.S.A.). November 12th, 1915.

17,868. Submarine sound signalling. Gardner. December 22nd, 1915. (Cognate application 10,058/16.)

18,212. Signalling. Colley. December 31st, 1915.

### 1917.

18,917. Vibration transferring means. H. Smith. August 23rd, 1916 (112,444.)

### 1918.

4,064. Dynamo-electric machines. Lancashire Dynamo & Motor Co. and H. B. Whitmore. March 8th, 1918. (124,249.)

4,074. Double-plug ignition means for internal-combustion engines. R. W. Standfield. March 8th, 1918. (124,250.)

4,750. Electric contact making and breaking apparatus. British Thomson-Houston Co. & H. K. Trechmann. March 18th, 1918. (124,258.)

4,760. Spark-plug and method of manufacturing same. F. M. Furber. March 17th, 1917. (115,813.)

4,840. Controlling-mechanism for electrically driven air compressors, pumps, or the like. British Thomson-Houston Co. & J. J. Ash. March 19th, 1918. (124,263.)

4,870. Bearings of magneto-electric machines. R. B. North & A. M. Allen. March 19th, 1918. (124,267.)

7,450. Electric vacuum cleaners. British Thomson-Houston Co. (General Electric Co., U.S.A.). May 3rd, 1918. (124,317.)

7,597. Method of forming connections to and between metal sheets or strips. Marconi's Wireless Telegraph Co. & F. Woods. May 6th, 1918. (124,320.)

8,062. Magneto-electric ignition apparatus. D. Y. Wheatley. May 14th, 1918. (124,325.)

9,735. Electric switches. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 13th, 1918. (124,338.)

10,120. Electric motor control systems. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 19th, 1918. (124,341.)

11,459. Instrument whereby short ends of carbon may be held securely whilst being used in electric arc lights. W. A. Gitsham. July 12th, 1918. (124,357.)

11,583. Electric fuse cabinets. W. T. Tallent-Bateman & British Westinghouse Electric & Manufacturing Co. July 15th, 1918. (124,358.)

11,595. Electric testing devices. R. C. Bierbower. July 15th, 1918. (124,359.)

14,530. Electric accumulators. W. G. Pearson & General Electric Co. September 6th, 1918. (124,378.)

15,450. Electric drive for ships' screw propellers. Akt.-Ges. Brown, Boveri et Cie. July 3rd, 1918. (124,380.)

15,541. Spark-plugs. E. J. Taylor. September 24th, 1918. (124,382.)

18,088. Electrical signalling systems for use on motor-road vehicles. Naillik Motor Signal Co. & J. P. Ogden. November 5th, 1918. (124,394.)

20,631. Electric induction motor meters. A. G. Landis & Gyr. December 11th, 1917. (121,482.)

20,793. Electrical phase converting systems. British Westinghouse Electric & Manufacturing Co. December 13th, 1917. (121,486.)

21,769. Apparatus for the conversion of direct electric currents to alternating currents. R. van Cauwenberghe. September 24th, 1917. (124,407.)

### 1919.

1,558. Means for securing the pole shoes of a magneto-electric machine. British Lighting & Ignition Co. & A. E. Bennett. January 21st, 1919. (124,411.)

**Output of U.S.A. and Canadian Generating Systems.**—Data of the outputs of all generating companies in the U.S. and Canada having yearly outputs in excess of 100 million KW.-hours are given in the *Electrical World* of March 26th, and statistics for 1917 and 1916 are included. The combined output of the 46 companies listed is more than 25,000 million KW.-hours, of which 4,500 million KW.-hours represents the output of companies in Canada. The increase in output for 1918 approximates 4,000 million KW.-hours. Although there was a serious dearth of water both in the Far Western States and in the South-eastern States, so that the ratio of output from water power to that from steam power is not so great as it was last year, still more than half of the energy produced was generated by hydroelectric plant. Owing to the consolidation the present Niagara Falls Power Co. tops the list with an output of more than 2,000 million KW.-hours. A most remarkable condition existed on the Niagara frontier, where during the year every bit of hydraulic and steam equipment was pressed into service because of the great demands for energy both in Canada and in the Niagara and Buffalo districts.